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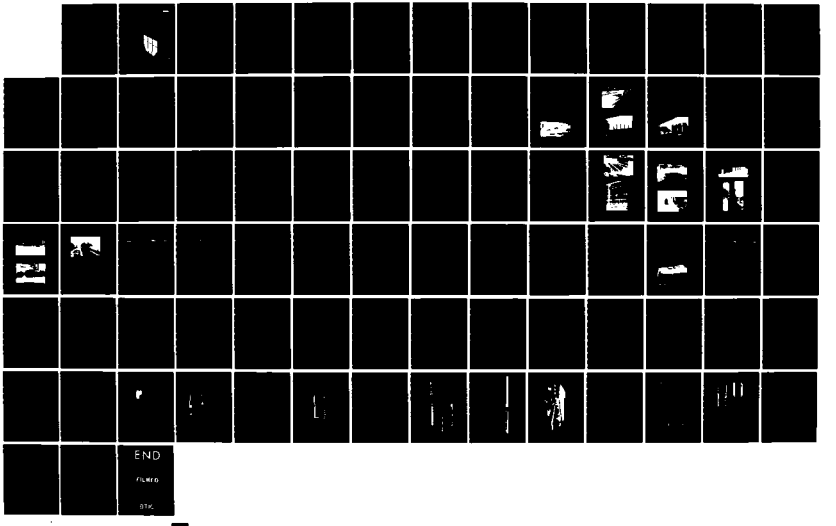
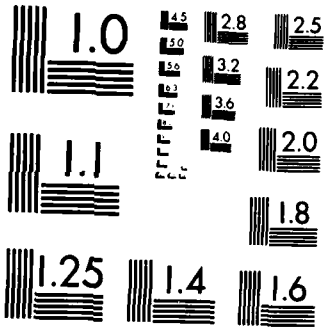


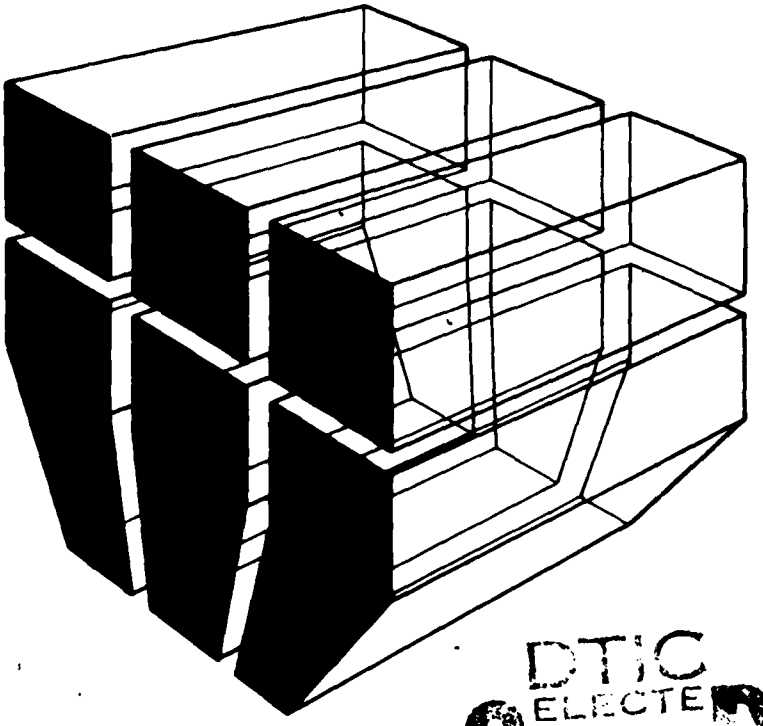


US Army Corps
of Engineers
Construction Engineering
Research Laboratory

TECHNICAL REPORT P-85/05
January 1985
(Industrialized Systems/Two-Step Procurement Pilot Projects)

INDUSTRIALIZED BUILDING SYSTEM/TWO-STEP PROCUREMENT PILOT PROJECTS: THREE CASE STUDIES

by
Thomas R. Napier
Michael E. Lierman



TECHNICAL REPORT P-85/05 INDUSTRIALIZED BUILDING SYSTEM/TWO-STEP PROCUREMENT PILOT PROJECTS: THREE CASE STUDIES JANUARY 1985

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To reduce the cost and construction time of military facilities, the Office of the Chief of Engineers (OCE) initiated a program to verify the applicability of industrialized building systems in military construction. Three projects from the FY82 Military Construction, Army (MCA) program were selected to model this program, which is a "design/build" approach called the "Two-Step Formal Advertising" procurement method.

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The U.S. Army Construction Engineering Research Laboratory (USA-CERL) was asked to report the results of such a program developed by OCE. To do this, USA-CERL monitored these three projects' development and interviewed personnel involved in each phase of construction through occupancy. Results indicate that the Two-Step Formal Advertising procurement method is a valid alternative approach under a variety of applications.

FOREWORD

This research was conducted for the Directorate of Engineering and Construction, Office of the Chief of Engineers (OCE), under Project 4A162731AT41, "Military Facilities Engineering Technology"; Task Area B, "Construction Management and Technology"; Work Unit 033, "Industrialized Building Systems/Two-Step Procurement Pilot Projects." The OCE Technical Monitor was T. Kenney, DAEN-ECE-A.

The work was performed by the Facilities Systems Division (FS) of the U.S. Army Construction Engineering Research Laboratory (USA-CERL). Contributions to this study were made by Professors Samuel T. Lanford and Christopher A. Moyer, School of Architecture, University of Illinois at Champaign-Urbana.

E. A. Lotz is Chief of USA-CERL-FS. COL Paul J. Theuer is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

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INDUSTRIALIZED BUILDING SYSTEM/TWO-STEP PROCUREMENT
PILOT PROJECTS: THREE CASE STUDIES

1 INTRODUCTION

Background

Military Construction, Army (MCA) requirements are projected to grow over the next few years as old structures are replaced or renovated. The Army therefore will need to refine its procurement procedure to take maximal advantage of opportunities that will produce the best, most economical results.

Three military building projects were designated as pilot projects within the FY82 MCA program to verify the effectiveness of an alternative approach to facility acquisition and construction. These projects were designed and constructed at costs between 28 and 32 percent below the Government Estimates for construction alone. Furthermore, two of these facilities were completed in 25 and 50 percent less time than normally anticipated. Design and construction quality have been described as "good" to "outstanding" in each case. The projects were located at Fort Drum, NY, Fort Benjamin Harrison, IN, and Fort Stewart, GA.

The approach used to execute these projects involves a "design/build" procurement method and industrialized, or preengineered, building systems. The key component of this approach is the Two-Step Formal Advertising procurement method, which entails performance-oriented construction documents and allows construction contractors to propose their own design and construction solutions. This opportunity is essential in allowing industrialized building systems to participate in a construction procurement. Preengineered building systems were used for two of the pilot projects; however, conventional construction techniques proved more economical for the third.

This procurement method complies with current Army Regulations and practices, even though it differs in some ways from Corps of Engineers' normal procedure. If it proves to be practical for MCA projects, this method could be used on a large scale for savings in overall project cost and construction time.

Objective

The objectives of this study were to (1) monitor the administration of each project and document experiences of the Corps Districts and outside agencies involved, (2) identify any problems associated with the design and procurement methods used by the Districts, (3) report the projects' results in terms of cost, time, and quality, and (4) use lessons learned to provide guidance for future applications of this approach by the Corps, Major Commands, and other military programs.

Approach

Contact was maintained with Corps District and field personnel throughout the projects' execution, and with the facilities' occupants upon close-out. Project bidders also were surveyed--both winners and losers--to assess reaction from the construction community. Previous experience and documentation in Corps systems building projects provided background for this evaluation.

Scope

This study was limited to three MCA projects chosen as case studies from the FY82 program.

Mode of Technology Transfer

It is recommended that the results of this work be used in developing Corps of Engineers guidance documents for two-step facility acquisition.

PROGRAM DEVELOPMENT

·ogram Objectives

Industrialization is finding increasingly greater application in the con-
ruction process. Economic savings can be realized through prefabrication,
·eengineering, and repetition of production techniques. Since more than 50
:rcent of the nonresidential, low-rise construction in United States uses
)me type of "industrialized" construction (preengineered metal building sys-
:ms), acceptance of these systems clearly is growing in many construction
ırkets.

In May 1980 the Office of the Chief of Engineers (OCE) directed that a
·ogram be developed to verify the effectiveness of "industrialized building
'stems" in military construction. The objective was to realize cost and time
ıvings over conventional construction techniques by taking advantage of pre-
ıbrication and industrialization.

Implicit in this directive was the need to address other aspects of the
ıcility acquisition process in order to purchase industrialized building sys-
:ms. These included implementation of a suitable procurement methodology,
ıpact of regulations and traditional procedures, and execution of each pro-
:ct at the District level. USA-CERL considered these procedural aspects to
: as critical to successful program execution as the building systems them-
:lves.

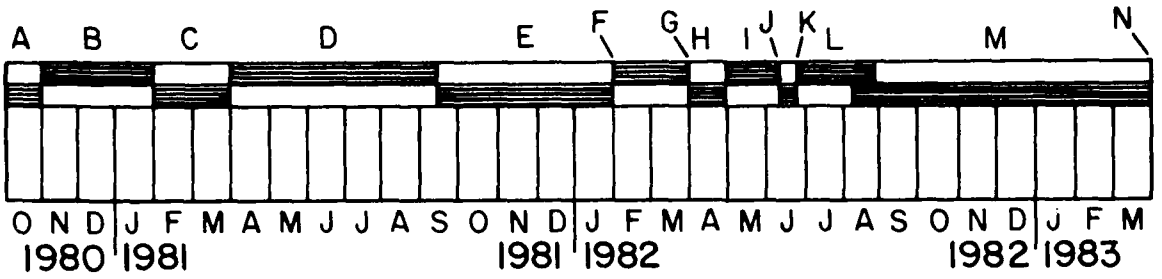
The program was to be composed of facilities from the FY82 MCA program.
ılike other research-oriented work with industrialized building systems in
ıich the Corps had been involved, these were to be "mainstream" MCA projects,
) be executed by the Corps Districts in the normal way. That is, they were
)t specially designated or administered research projects.

ıcility Selection

OCF selected more than 20 facilities from the FY82 MCA program that were
)nside ·d to have potential for application of building systems technology.
ıey wei ·d in Corps Districts within the Continental United States and
)nsisted ma... administrative, headquarters, and supply facilities. They
:re selected based on line-item descriptions in the FY82 MCA program. It was
ıticipated that some facilities could be aggregated into the same construc-
ion contracts to improve economies of scale by creating a larger contract,
ıich would make industrialization more attractive.

Attrition in the FY82 MCA program eliminated all but three of the candi-
ıte facilities, which were located in different Districts. Thus, the "pro-
:am" is more accurately described as a collection of three independently
ıministered building projects, with selection based on survival in the FY82
:A program. The sites included a battalion headquarters and classroom at
)rt Drum, NY, a physical fitness center at Fort Benjamin Harrison, IN, and a
ire station at Fort Stewart, GA.

PROJECT EVENTS



Project Events Key:

A - A/E Contracted

B - Design Concept Development

C - Design Concept Review/Approval

D - Prepare RFTP

E - RFTP Review/Approval

F - Advertise RFTP

G - Step 1/Technical Proposals Due

H - Step 1/Technical Proposal Evaluation

I - Invitiations for Bid (IFB)

J - Step 2/Bids Due

K - Contract Award

L - Completion of Construction Documentation

M - Construction

N - Beneficial Occupancy

Figure 5. Project events by month--Fort Drum.

Conclusions

Time savings were realized in two areas of this project--construction and construction administration. In other areas of the project (e.g., design and RFTP development), the time spent was comparable to a conventional MCA project. However, the District attributes this to a lack of experience with two-step procurement, indicating that once the procurement process and RFTP development become more routine, time to develop the RFTP should be reduced by two-thirds. Figure 5 shows the time by month for each project event.

Time savings in construction can be attributed to using both preengineered building systems and the two-step procurement method. Preengineered systems have been shown to speed construction documentation, review, and approval of the structural design, as well as actual construction. In addition, two-step procurement provides the opportunity to complete construction documentation in phases during actual construction, thus enabling work to begin much sooner after contract award.

The time savings cited above saved money as well. A proposer's bid price will be affected by the length of the construction period anticipated for the project. For this project, the contractor cited overhead costs of roughly $2000 to $3000 per week just for time spent onsite; with a shorter anticipated construction period, any savings estimated as a result will be reflected in a lower bid price. In addition, the two-step process has been shown to greatly reduce cost modifications to the construction contract. Since the contractor generates the final design and construction documents, the Corps does not have to assume responsibility for the cost of any errors or deficiencies in those documents. The contractor for this project also identified cost savings from using preengineered building systems. Figure 6 gives a graphic cost comparison for this project.

Corps personnel agreed that some user-initiated design changes may have been avoided if the battalion had had more input at the time of design and RFTP development; however, the quality of design and construction are at least as good as expected with any traditional MCA project. Moreover, the contractor stated that because his company generated the design, more attention was devoted to the actual construction and quality of the end product.

Overall, the Corps administrative effort was no greater, and in some areas, less, than normally expected with a conventional MCA project. The primary area of improvement was judged as finding a way to expedite RFTP development and review/approval of the contractor's construction documents.

Close-Out and Occupancy

Close-out procedures for this project were the same as for a conventional construction contract. Overall, it appears everyone is pleased with the quality of the facility. The contractor expressed a willingness to deal with the Corps again and, as a result of this experience, said his company would be able to recognize additional savings in the next two-step project, which would be reflected in the bid price.

Battalion personnel occupying the facility have commented that they are generally pleased with the facility. However, the battalion captain in charge of monitoring the new facility has cited some design shortcomings that might have been avoided. Apparently, midway through the procurement procedure, the battalion assigned to occupy the facility had a change in personnel, so that the current battalion staff never had an opportunity to review design development or construction documentation. Had they had such an opportunity, the battalion captain reported that many of the design drawbacks cited probably could have been avoided. However, this problem does not appear to relate to the two-step procurement method. Figure 4 shows the completed facility.

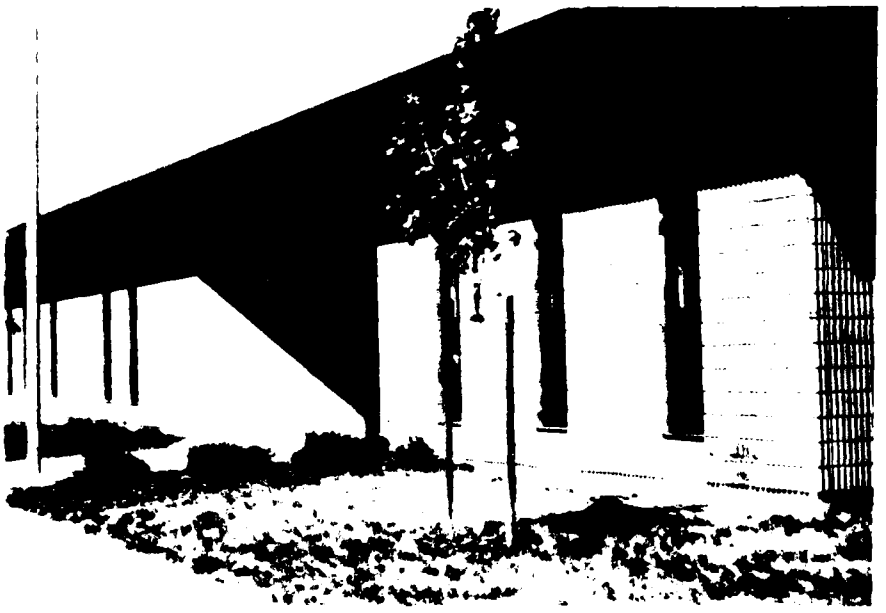


Figure 4. Completed facility--Fort Drum project.

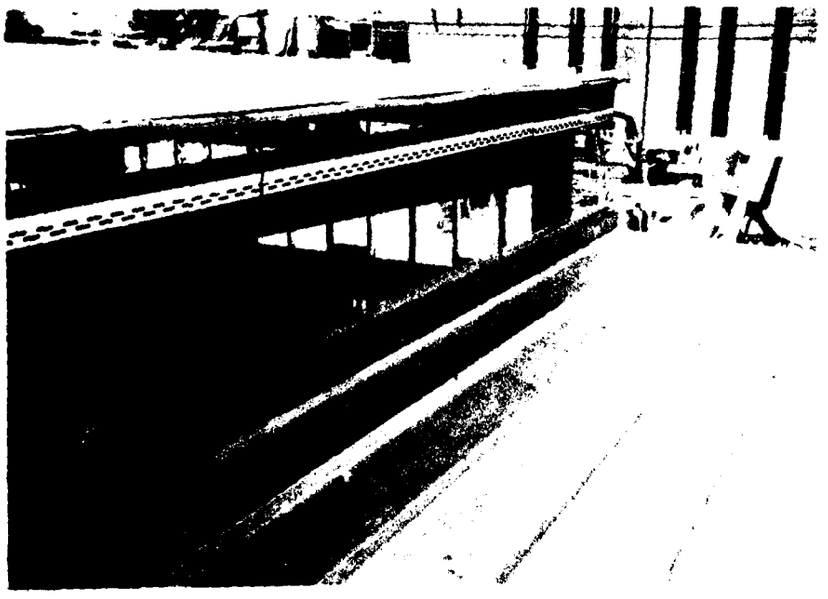


Figure 2. Standing seam roof system--Fort Drum project.

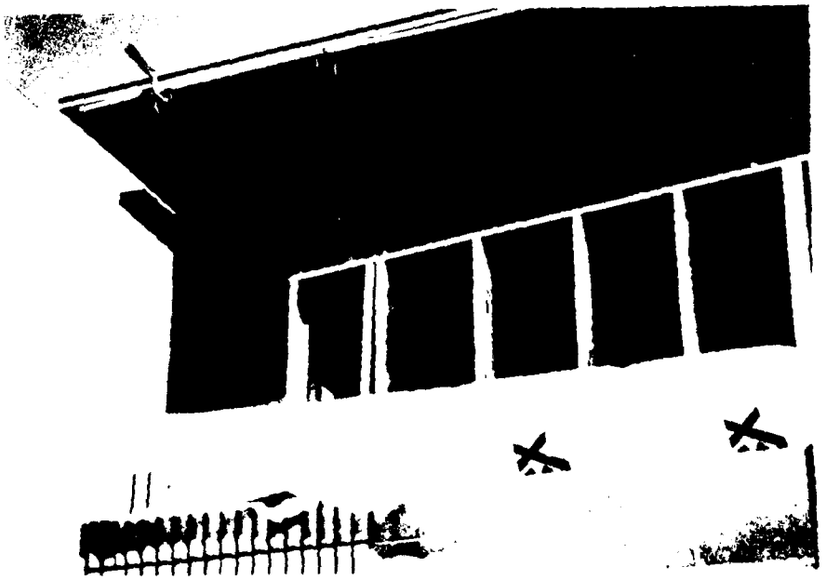


Figure 3. Preengineered superstructure/conventional wall interface--Fort Drum project.

the RFTP, which omitted a requirement for a telephone conduit system. A change order resulted which cost approximately $20,000. All additional costs due to change orders were well below the programmed contingency amount of 5 percent of the construction contract cost.

Building Technology

The building's construction was based on an Armco preengineered building system. The "industrialized" elements consisted of the preengineered steel superstructure, roof support and roofing, and various architectural trim and accessory items. Figure 1 shows the preengineered steel superstructure, which is a rigid-frame, multiple-span structural layout. Figure 2 shows the standing seam roof system which consists of aluminized steel panels attached to Z-purlins with concealed fasteners. The fascia, soffit, guttering, and other accessories are also part of the building system.

All other construction used conventional materials and methods. Exterior wall construction consisted of the prescribed concrete masonry units and metal stud back-up. Figure 3 shows the interface of the preengineered superstructure and the "colateral" (conventional) wall materials. Interior construction consisted mostly of steel stud and gypsum board partitions and a suspended ceiling. A masonry firewall separated the classroom and administrative areas of the facility. All other finishing and mechanical, plumbing, and electrical work were installed by conventional methods.

Figure 1. Preengineered steel superstructure--Fort Drum project.

could have proposed a conventional construction solution or even could have bid on a conventional design. However, he chose a preengineered building system because (1) the components are prefabricated and ready for fast delivery, (2) standardized construction procedures (called a "giant erector set"), can be used, and (3) he would have to deal with only one supplier for most major building components. The third reason alone is a great advantage because the contractor avoids having to coordinate and rely on several additional suppliers. The contractor estimated that a conventionally designed and constructed building would have added 2 to 3 months to overall construction time, delaying other activities necessary to enclose the building before winter.

The project was administered in essentially the same way as a conventional MCA project--for the most part without incident. Quality assurance (QA) also was handled in the same way as for conventional MCA construction administration. For systems and subsystems built offsite, a certificate of compliance was required. The Corps Area Office and Construction Division had no problem verifying that the quality levels specified in the RFTP and proposed in step 1 were maintained throughout the construction process. Checking compliance often was simply a matter of ensuring the products were those the contractor had originally specified and had been approved. The Corps project engineer stated that QA was not sacrificed at all with the two-step procurement.

Payment procedures were treated in the usual way. For fabrication not yet installed, the District paid for materials onsite or when the contractor acquired the title.

No contractor-initiated change orders were requested throughout this project. This is because with two-step procurement, the contractor, not the Corps, assumes the responsibility for generating design and construction documentation. The District initiated the only change orders. One change was needed when unexpected site conditions were discovered during construction; the using agency also had requested a design change after contract award. In addition, some oversights were discovered in the RFTP, which required some extra work by the contractor. According to the project engineer, however, at least five change orders were avoided because the contractor generated the design and documentation.

The project engineer commented that he spent about the same time and effort supervising and administrating (S&A) this project as for conventional construction, although it was intensified to some degree because of the short duration. However, he saw the potential for savings once the procedure is well understood (i.e., reviewing construction documentation, fewer change orders, verifying QA, accelerated construction periods). He added that this project probably recognized some savings in other District overhead costs (e.g., typing and other paperwork), but exact figures are difficult to document. Overall, the District's project engineer maintained that the single most important factor for smoothly executing a two-step construction contract is a good cooperative working relationship between the Corps and the general contractor.

The facility's final construction cost totaled approximately $863,821, which is about $21,000, or 2.5 percent, over the contractor's step-2 bid price ($842,800). Most of this cost increase has been attributed to an oversight in

The RFTP stated that the Corps would be allowed a minimum of 15 days to review the contractor's construction documentation submittals. There was, however, no maximum time indicated that the District could take to approve the documents. After initial review, TEG requested that some revisions be made and the documents be resubmitted. The Construction Division, realizing that delays in initiating construction would seriously burden the contractor's anticipated schedule (and overhead), allowed the contractor to begin work with approved phases of documentation such as site preparation and foundation work.

During this review process, the District indicated a 60-day review and approval time would have been more realistic. Both the District's project engineer and the contractor said that some of the problems experienced with the document review and approval were related to the RFTP. They indicated that it should have provided more guidance, primarily in describing the submittal/review/approval process, times, personnel involved, and responsibilities of the parties involved. In addition, it appears that more parties than originally anticipated (or perhaps necessary) became involved with reviewing the contractor's submittals; review comments began to reflect personal preferences rather than simply checking for minimal conformance to the contractor's step-1 proposal and the criteria contained in the RFTP. The project engineer and the contractor noted that the process suffered somewhat from too many divergent interests being involved. However, construction document review and approval was the only area of the project that created any real difficulty for the District.

Construction Administration

The RFTP stated that the contractor was to complete the entire facility and have it ready for use within 550 calendar days (approximately 18 months) after the date of receiving the NTP. The contractor acknowledged receipt of the NTP on 22 July 1982, and within 3 months, all foundation, structural, roofing, exterior wall construction, and exterior paving had been completed. Within the next 3 months, all interior work had been completed and the contractor had begun preliminary punch list work. By 15 February 1983, only final punch list work and exterior seeding remained to be completed. The District accepted the facility for beneficial occupancy 1 April 1983, even though the 76th Engineer Battalion assigned to the facility was not originally scheduled to occupy the building until August. Thus, a project that was expected to take 550 calendar days was completed in approximately 250, some 300 calendar days less than typically expected.

The project engineer and the contractor have identified five factors contributing to the faster construction period realized: (1) combining design and construction responsibilities, (2) allowing construction to begin even though some documentation required revision and resubmittal, (3) awarding the contract late in the construction season--the building needed to be enclosed before winter arrived, (4) establishing a cooperative working relationship between the Area Office and the contractor, and (5) using a preengineered building system.

The contractor commented that he has previously found preengineered systems to provide both cost and time saving advantages over a conventional masonry/bar-joist/built-up-roofing design. Also, as a general contractor, he

Table 1

Cost Comparison Summary: Fort Drum

a.	Government Estimate		
(1)	Design*		$ 49,000
(2)	Bid**		1,173,250
(3)	Supervision and Administration (S&A)***		58,862
(4)	Construction Contingencies***		58,862
(5)	Total Estimated, Conventional Design and Construction		$1,339,974
b.	Actual		
(1)	Design (RFTP preparation, proposal evaluations)		$ 64,000
(2)	Bid (design and construction)		842,800
(3)	S&A+	less than	42,140
(4)	Construction Contingencies		21,021
(5)	Total Actual, Design and Construction	less than	$ 969,961
	= 28% less than conventional		
c.	Construction Costs Only		
(1)	Government Estimate		
	Contract Cost		$1,173,250
	S&A		58,862
	Contingencies		58,862
	Total Construction Cost		$1,290,974
(2)	Actual		
	Construction Cost‡		$796,800
	S&A	less than	42,140
	Contingencies		21,921
	Total Construction Cost	less than	$ 859,961
(3)	Construction Cost Difference	more than	$ 431,013
	= 34% less than conventional		

*Conventional design estimated at approximately 4.5 percent of the conventional construction estimate.
**Government Estimate for construction, based on conventional.
***Five percent of Government Estimate.
+Five percent of bid amount.
‡Contract amount minus contractor's AE design costs.

RFTP, and all bids came in below the Government Estimate. Table 1 provides a detailed cost comparison.

At the outset of this project, some District personnel had expressed reservations about contractors participating in this procurement due to the effort necessary to prepare proposals with no guarantee of award. However, results were considered to be quite good, especially given that this was the District's first experience with two-step procurement. The contractor stated that the cost to prepare this proposal was considerably higher than a typical bid preparation--about three times more. He did, however, indicate that this was an appropriate effort for this type of procurement and felt it was an acceptable "cost of doing business." He also suggested that the proposal process should progress more smoothly once the Corps and local construction community gained experience. This contractor indicated he would participate in future two-step procurements.

Construction Documentation

The RFTP required the winning bidder to submit for review all final construction documentation within 60 days of the Notice to Proceed (NTP). In addition, the RFTP gave winning bidder the opportunity to phase the submittal of documentation with construction "if circumstances require."

The final construction documentation included construction drawings, specifications, and calculations for structural, mechanical, electrical, and outside utility work. All documentation was required to comply with the contractor's step-1 proposal and with the design and technical criteria contained in the RFTP. In addition, enough detail had to be provided to determine the quality of materials and workmanship required. District personnel considered the quality of the contractor's construction documents to be as good and as detailed as those found in a conventional MCA project.

Construction documentation was speeded because of the relatively simple facility design and the use of a preengineered building system. Little structural design was required of the contractor, since the building system's structural analysis and design already had been conducted by Armco, the manufacturer. Furthermore, the preengineered system enabled extensive use of standard construction details. By the time the winning bidder received the NTP, about 1 month after contract award, all the required documentation had been completed and was ready for review.

The District retained the Ehrenkrantz Group (TEG) to review the contractor's construction documents and verify that they conformed with the step-1 proposal and the criteria contained in the RFTP. The District's technical sections reviewed the documents as well. The District project manager's opinion was that the review should require less effort than conventional design final review. The contractor's use of a preengineered system eliminates the need for exhaustive structural review since the building systems manufacturer provides the automated structural analysis.

systems franchised contractors. No areas of ambiguity or controversy about the project were identified at this meeting.

The proposal contents listed in the RFTP essentially consist of the floor plan, structural layout, typical wall sections, elevations, outline specifications, structural calculations, preliminary calculations for mechanical and electrical equipment selection, and manufacturer's literature for designated products and materials. Appendix B contains the winning proposal contents and drawings.

Eight proposals were received, three of them using preengineered metal building systems. The other proposals represented variations of steel frame and masonry construction. It should be noted that considerable diversity was evident in the proposed construction solutions. Although the RFTP did not allow a great deal of latitude in building configuration or materials, no two proposals could really be called similar. Variations were seen in structural layout and detailing, wall construction, roof and roofing configurations, and mechanical design.

Proposals were evaluated by the District's technical sections, the AE, the Fort Drum area office, and a U.S. Army Forces Command (FORSCOM) representative. At the District's invitation, USA-CERL also participated in the evaluation. The proposals were distributed to these offices for individual evaluation, and a meeting was scheduled for a final, combined assessment. This review session was scheduled to last for 2 days, although one long day turned out to be enough. Proposals were evaluated for conformance to the criteria specified in the RFTP, which was, for the most part, done with little difficulty. All eight proposals were judged to be acceptable. The entire evaluation process took approximately 3 weeks.

A few features of this evaluation process complicated matters to some degree. The most common situation was the need to request further information from all proposers. In some cases, required submittals were simply omitted (i.e., the proposal did not conform to the RFTP). However, most material was submitted per RFTP instructions, but still needed clarification. In all cases, proposers were notified that a description of corrective measures would be required to bring the proposals into conformance.

In a few instances proposals required changes even though they were in conformance with the RFTP. This occurred when it was decided that a proposed detail or material would not be satisfactory for the facility, though not in conflict with the specifications. In one instance, it was decided that the fenestration arrangement shown in the RFTP drawings should be changed. This change was made through amendment to the RFTP.

The District invited bids from all eight proposers. The R. M. Buck Construction Corp., Whitesboro, NY, was awarded the contract, having submitted the low bid of $842,800--28 percent below the Government Estimate of $1,173,250. R. M. Buck is a franchised contractor for Armco Building Systems, the preengineered system on which the proposal was based. Max Ratner AIA, Peninsula, OH, was the architect for R. M. Buck. The second lowest bid also represented a preengineered building system contractor. The lowest bid for a proposal using conventional construction methods was some 10 percent higher than the winning bidder. A maximum contract award amount was indicated in the

material alternative for that subsystem or component. For example, performance criteria were specified for the building's structural system accompanied by descriptive material specifications for preengineered metal building systems, structural steel, precast concrete, and concrete for buildings, which were standard Corps of Engineers Guide Specifications. This approach created a rather complex bid package. However, it did allow companies to propose a variety of construction solutions. USA-CERL found three drawbacks with this RFTP as written: (1) it was sometimes difficult to discern the minimum acceptable levels of performance, (2) the acceptability of alternatives not listed was unclear (e.g., could they be proposed and, if so, against what standard would their acceptability be measured), and (3) there were possible conficts between performance and descriptive criteria. The District and the AE firm made some adjustments to the technical provisions to dispel these concerns, and the final product was a document yielding positive results.

The drawings were essentially concept-type plans, elevations, and sections. They displayed only overall dimensions and no construction details. Mechanical and electrical layouts were presented schematically. Proposers were to select their own structural materials and layouts, dimensions, and details, but were to conform to the plan and overall architectural character shown in the drawings. The fluted concrete masonry exterior had to be provided as specified. All mechanical and electrical materials and equipment were specified descriptively, although proposers were to develop layouts and definitive designs. The site plan displayed the building's location and orientation, paving, grading, utilities layouts, and landscaping similar to a conventional site plan.

The RFTP made no explicit reference to the use or opportunity to propose industrialized building systems. The only indication of this opportunity was through the inclusion of such methods in the technical specifications.

It took roughly 15 months from initiation of design activities to advertisement of the RFTP. District personnel noted that this took longer than it probably should have, and attributed it primarily to this being their first experience with two-step procurement and to their unfamiliarity with performance-oriented specifying. They have also identified ways to speed up this process in the future. Appendix A gives an expanded outline of the RFTP's contents.

Bidding

The District advertised the project in the Commerce Business Daily (CBD), requesting design and construction proposals for the facility. In addition, contractors on the Districts' bidder list were notified, as were the preengineered building systems contractors and design/build contractors identified during RFTP development. Time allotted for preparation and submittal of proposals was 8 weeks.

The District conducted a preproposal meeting at Fort Drum about a month before the proposal deadline to explain and discuss the procurement procedures as well as some of the RFTP's technical provisions. The 20 or so attendants consisted mainly of architect/general contractor joint ventures and building

The MCA design status reporting was one aspect of the concept design phase differing from a conventional MCA project. A conventional concept design is defined as "35 percent design completion," whereas comparable progress toward RFTP completion represents a considerably lower percentage. In the Engineering Instructions, OCE defined "35 percent complete" to include preliminary site and utilities design, floor layouts, preliminary cost estimate, and outline specifications. The District reported concept design completion accordingly.

During the concept development stage, several issues arose that were not typical of a conventional MCA project, requiring resolution between the District and AE firm. Initially, the firm and the District were unclear as to what was intended by the term "industrialized building systems." The Ehrenkrantz Group had extensive building systems experience with large-scale state school construction programs, but was uncertain how such an approach applied to a single $1 million building. Furthermore, the AE expressed concern about the local construction community's ability to provide the necessary design/build services for two-step procurement. USA-CERL clarified the project's objectives as the application of currently available ("off-the-shelf") building systems. USA-CERL also identified preengineered building systems contractors and design/build contractors who would be capable of and interested in this project.

The District and AE also questioned the use of standard descriptive construction criteria in a performance-oriented RFTP. The AE contended that it would be unrealistic to convert all Guide Specifications provided by the District into equivalent performance specifications. Therefore, acceptable material alternatives were designated and descriptive guide specifications were included for each alternative. The AE firm stated it should be easier for local contractors to develop proposals in response to these specifications.

Finally, Fort Drum and the using agency were unaccustomed to a building's design being presented in a nondefinitive way with the final design and details unknown. As a result, a fairly definitive design was developed that satisfied the user's requirements and from which proposals could not depart to any great degree.

RFTP Development

A final RFTP was advertised consisting of a general discussion of administrative provisions and the procurement method, proposal forms, special provisions, technical specifications, and drawings. Administrative provisions essentially provided an explanation of the two-step procurement process and requirements for developing and submitting a proposal. These included a description of technical proposal material. The special provisions were standard construction contract items that applied directly to step 2 only, but were included in the step-1 RFTP as information to firms making proposals.

The technical specifications were performance-oriented, although not "performance specifications" per se. General functional requirements and performance criteria were specified for each major building subsystem or component. Descriptive specifications were then included for each acceptable

3 FORT DRUM BATTALION HEADQUARTERS AND CLASSROOM

The headquarters and classroom facility was built for the 76th Engineer Battalion which was moving to Fort Drum, Watertown, NY, from Fort Meade, MD. It is a training and administrative facility housing the commander's office, general administrative functions, and a 200-pers' classroom. The building is single-story and roughly 14,850 sq ft* in size. Design and construction were administered by the Corps' New York District.

Predesign Activities

OCE issued Engineering Instructions that included a discussion on industrialized building systems and directed initiation of a two-step procurement method. The instructions also indicated that, if the District were to contract for architectural engineering (AE) services, selection criteria should include proficiency with performance specifying and experience with industrialized building systems projects. These instructions made no other reference to this being any sort of special case. The project was assigned to an Army Section project manager in the usual way. This was the District's first experience with two-step procurement for an MCA facility.

The District hired an AE firm (The Ehrenkrantz Group, New York, NY) to prepare a concept design and RFTP and to participate in proposal evaluation and construction drawing review. The fee for concept design and RFTP preparation was approximately $48,000.

The District project manager assembled and transmitted design and construction criteria to the AE firm as usual. These documents included Technical Manuals, Engineering Manuals, Corps of Engineers Guide Specifications, and other descriptive criteria usually associated with AE design services. All other predesign activities were conducted routinely.

Concept Design

The AE firm developed a concept design for the facility based on input from Fort Drum personnel and the using agency (the 76th Engineer Battalion). One specific requirement was for a fluted concrete masonry exterior to match a new barracks complex adjacent to the project site. The using agency had also indicated requirements for fairly definitive space arrangements and building layout. The overall building design was compatible with preengineered building systems as well as a variety of conventional construction methods.

The concept design material consisted of a site plan, floor plan, building elevations and sections, outline specifications, and a cost estimate. The architectural drawings displayed only overall building dimensions and no construction details. The specification outline relied mostly on the Guide Specifications provided, and the cost estimate was based essentially on conventional steel frame construction methods.

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*To convert into metrics, 1 sq ft = 0.092 m^2.

Ideally, a selection process based on scientific methodology or survey of local capabilities might have been conducted to better establish the programs' chances for success. Instead, initial selection was based on professional intuition about the building types and systems' capabilities and assumptions about local availability.

Facility Acquisition Approach

Two-Step Formal Advertising was the procurement method to be used for each of the three projects. Building systems frequently are proprietary and diverse enough in configuration and detail that the Corps' traditional design-bid-build approach is not always suited to competitive acquisition. Furthermore, it was not considered appropriate to exclude conventional construction techniques from participation. Two-step procurement was the only current "design/build" method allowed in MCA by which bidders can propose dissimilar construction solutions.

In step 1, a Request for Technical Proposal (RFTP) is advertised for each project. Interested firms submit design and construction proposals based on the requirements and specifications stipulated in the RFTP. Proposals are then evaluated for conformance to the RFTP. In step 2, each compliant firm is asked to bid. The contract award is based on lowest responsive bid.

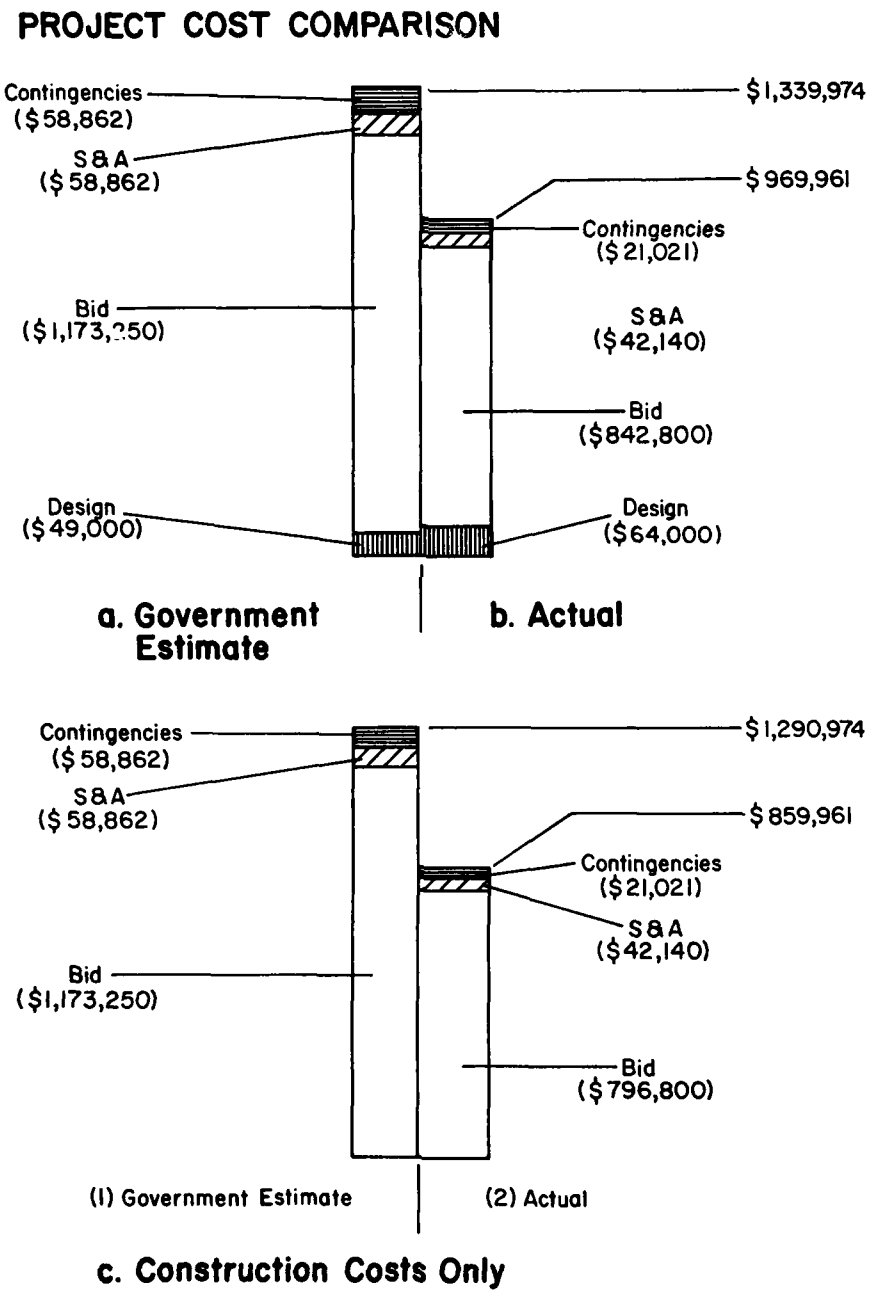


Figure 6. Cost comparison--Fort Drum project.

4 FORT BENJAMIN HARRISON PHYSICAL FITNESS CENTER

The physical fitness center at Fort Benjamin Harrison, Indianapolis, IN, is a multipurpose facility for training and installation-wide sports and recreation. At roughly 48,000 sq ft in size, the center houses a competition gymnasium, natatorium, exercise and training equipment, and handball/racquetball courts. Design and construction were administered by the Corps' Omaha and Louisville Districts, respectively.

Predesign Activities

OCE issued Engineering Instructions for the project. Like the Engineering Instructions for the other pilot projects, they included a discussion of industrialized building systems and directed that two-step procurement be initiated. Again, they did not indicate that this was a "pilot project" or any sort of special case. The project was assigned to a Military Section project manager. Both the Omaha District and project manager, however, had had previous experience with design/build procurement and prefabricated construction. The project manager had recently been involved with a 392,000-sq ft administrative facility that used design/build, fast-track contracting and many prefabricated building components. This project had been quite successful in terms of cost, time, and quality.[1]

Omaha District had recently completed a similar physical fitness center at Fort Leonard Wood, MO. Both Districts and Fort Benjamin Harrison were pleased with that design and essentially wanted to duplicate the plan at Fort Benjamin Harrison.

The District elected to complete the RFTP inhouse and did not seek outside AE services. All other predesign activities proceeded in the usual way.

Concept Design

The District developed a concept design based on the existing physical fitness center design, adapted to the Fort Benjamin Harrison site. One requirement was to connect the new facility to an existing gymnasium and to create a central administrative and control point for the combined facilities. There were no specific esthetic requirements--such as matching materials or architectural style--as the immediate vicinity consisted mostly of open space and buildings of mixed architectural styles.

The concept design material consisted of facility plans, outline specifications, and a preliminary cost estimate. The facility plans were definitive floor plans, but showed only overall building dimensions. No construction type or structural arrangement was implied. It was intended that this plan

[1] M. G. Carroll and T. R. Napier, A Case Study for Industrialized Building Products and Innovative Building Delivery Techniques for TACOM Facilities in Warren, MI, Special Report P-143/ADA128539 (U.S. Army Construction Engineering Research Laboratory, 1983).

would be included in the RFTP, but could be modified by proposing firms as they saw fit.

Because the RFTP was to be a performance-based document, the District judged the traditional descriptive criteria as not applicable to this type of procurement. The technical specifications cited functional requirements for the building and referenced model building codes and industry standards. This approach omitted much of the descriptive construction criteria normally included in Corps specifications, and allowed virtually any construction method that met basic functional requirements.

Cost was then estimated for the project. Although any construction method and material were to be allowed, some type of steel frame construction was determined to be the most economical and, therefore, the most likely to be proposed. The concept estimate reflected that construction type.

In accordance with OCE's Engineering Instructions, the District reported design progress as "35 percent complete" in the MCA design status report. OCE had defined this percentage for a two-step procurement as the preliminary site and utilities design, floor layouts, preliminary estimate, and outline specifications.

The District indicated no difficulties or unusual situations during concept development. However, a few issues arose related to two-step procurement that were not typical of a conventional MCA project. For example, the District was able to judge traditional descriptive construction criteria (e.g., Corps of Engineers Guide Specifications) as inapplicable to this type of procurement because Federal Acquisition Regulations (FAR, entitled "Defense Acquisition Regulations" at the time of the project) allow industry standards and specifications to replace military criteria where suitable standards exist. (The Missouri River Division supported this approach.) The District was somewhat uncertain about how "open" the RFTP should be to various construction methods. On one hand, the procurement method was intended to allow proposal of any suitable construction method; on the other hand, it was apparent that steel frame construction of some type held an economic advantage over other construction types, and thus would most likely be proposed. It was decided that the RFTP should remain open to any suitable construction method and that the bidding stage would determine the economic advantage.

RFTP Development

A final RFTP was advertised consisting of an introduction, instructions for proposal preparation, discussion of proposal evaluation and bidding procedures, site data, technical specifications, and drawings. No construction contract material was included, as it would be provided with the step-2 Invitation for Bid.

The RFTP section provided a brief description of the project, discussion of the two-step procurement, and general information about proposal development and submittal. The instructions for proposal preparation described proposal format, identification, and submittal.

The technical specifications included a foundation report, environmental protection provisions, proposal submittal documents, and specifications for sitework and the building. An architectural program described layout and functional requirements for the facility, room and area requirements, equipment requirements, and other esthetic and architectural design considerations. Specifications for the building systems and components consisted of basic functional requirements and references to industry standards and specifications. For example, industry standards were cited for the building's structural design and materials. These standards were from the American Concrete Institute, American Institute of Steel Construction, Metal Building Manufacturers Association, National Concrete Masonry Association, and the Uniform Building Code, among others. Structural loads and conditions were specified to which the proposer was to apply the appropriate standard for the construction type selected. This approach streamlined the specification and allowed virtually any construction method to be proposed.

The drawings included only a plan of the existing site and utilities and floor plans for the building. The proposer was to develop a site design. The floor plans were definitive, but gave only overall building dimensions so that proposing firms could modify the given plan or develop their own plans, as long as the basic functional relationships shown in the RFTP plan were maintained. No elevations or sections were included in the drawings. Considerations for building form and esthetics were described in the specifications, but the proposer was to develop an architectural design. The RFTP included a statement encouraging "preengineered/preconstructed" building systems, although this was by no means a requirement for the project.

It took approximately 8 months from the initiation of design to RFTP advertisement. Appendix A is an expanded outline of the RFTP's contents.

Bidding

In this project, RFTP advertisement created a situation not normally found with conventional MCA projects: the project was advertised before construction funding was authorized. In a conventional project, the design is ideally completed by the end of the fiscal year (the Design Year) so that the bid package can be advertised immediately upon receipt of construction funding. This is supposed to occur on 1 October of the year in which the construction contract is to be awarded (the Budget Year). Federal Acquisition Regulations (FAR) prohibit committing the Government to expenditure before funds are available; thus, the usual Corps practice is to not advertise a project until funding is authorized or the authorization is imminent.

However, the RFTP was completed more than 4 months before the new fiscal year on 1 October. The District, anticipating this hurry-up-and-wait situation, requested authority from the Division to advertise step 1 rather than delay proposal development until after the new fiscal year. The Division forwarded the request to OCE's Construction Division and authority was granted since proposal development does not constitute an obligation to the Government. The RFTP was, however, to indicate to proposers that progress to step-2 bidding depended on receipt of construction funding and would not be allowed until then.

The District advertised the RFTP in CBD, contacted contractors on its bidders' list, and notified some preengineered building systems franchise contractors as USA-CERL had recommended. Approximately 10 weeks were allowed for proposal development at first, but an amendment extended that time an additional 2 weeks.

The RFTP stated that proposals must contain floor plans, elevations, sections, a black-and-white perspective, outline specifications, and written narratives. Appendix B shows the winning company's drawings.

Thirteen proposals were submitted by eight proposers (some submitted more than one proposal). Of these, 10 proposals used preengineered or prefabricated construction to some degree; they were either preengineered metal building systems or precast concrete construction. The remaining proposals were for conventional steel frame and masonry construction.

The proposed designs had considerable diversity, with few considered similar. Proposers followed the plans provided in the RFTP to varying degrees, and some completely original designs were developed as well. Variety in exterior materials and overall architectural appearance is further evidence of creativity in these proposals. District personnel went so far as to describe some proposals as "really exciting" in their imagination and innovation.

Proposal documents were distributed among the District's project manager and evaluators in Technical Sections. Proposing agencies were identified only by a number provided with the RFTP, so the evaluators were unaware of proposers' identities. (This information was recorded in the District's Procurement and Supply Division.) Each evaluator examined the proposals individually, after which a one-day formal evaluation meeting was conducted. One proposal was judged unacceptable because of noncompliance to the esthetic requirements specified in the RFTP. All other proposals were found acceptable as submitted or pending minor corrections. The District took roughly 3 months to evaluate proposals and issue IFBs. This length of time was taken because the onset of winter precluded any sense of urgency in inviting bids and awarding a contract. The RFTP had indicated approximate dates for issuing the IFB and awarding the construction contract.

The District invited bids from the eight proposers. Guepel DeMars, Inc., Indianapolis, IN, was awarded the contract, submitting the low bid of $2,546,000--27 percent below the Government Estimate of $3,500,000. Guepel DeMars also is involved in construction management, design/build construction, and other diversified construction services in addition to general contracting. The AE firm hired by Guepel DeMars, Cuppy Associates, Carmel, IN, developed its proposal using an Armco Building System. The lowest bid for a proposal using conventional construction methods was some 20 percent higher than the winning bid, and that proposal made extensive use of prefabricated concrete wall panels. The RFTP had indicated only an estimated range for construction cost between $1,000,000 and $5,000,000, without giving a ceiling. The IFB did indicate a maximum contract award amount, however, and all bids came in below the Government Estimate. Table 2 provides a detailed cost comparison.

Table 2

Cost Comparison Summary: Fort Benjamin Harrison

a.	Government Estimate		
(1)	Design*		$ 148,500
(2)	Bid**		3,500,000
(3)	Supervision and Administration (S&A)		175,000
(4)	Construction Contingencies***		175,000
(5)	Total Estimated, Conventional Design and Construction		$3,998,500
b.	Actual		
(1)	Design (RFTP preparation)		$ 30,000
(2)	Bid (design and construction)		2,546,000
(3)	S&A+	less than	127,300
(4)	Construction Contingencies		100,000
(5)	Total Actual, Design and Construction	less than	$2,803,300
	= 30% less than conventional		
c.	Construction Costs Only		
(1)	Government Estimate		
	Contract Cost		$3,500,000
	S&A		175,000
	Contingencies		175,000
	Total Construction Cost		$3,850,000
(2)	Actual		
	Construction Cost‡		$2,415,000
	S&A	less than	127,300
	Contingencies	less than	100,000
	Total Construction Cost	less than	$2,642,300
(3)	Construction Cost Difference	more than	$1,207,700
	= 32% less than conventional		

*Conventional design estimated at approximately 4.5 percent of the conventional construction estimate.
**Government Estimate for construction, based on conventional.
***Five percent of Government Estimate.
+Five percent of bid amount.
‡Contract amount minus contractor's AE design costs.

The District personnel indicated that, although the winner presented an entirely satisfactory proposal, some other proposals offered outstanding design and construction solutions and were bid well within the budget. Thus, there may have been potential for overall greater quality at only nominal extra cost. This is one shortcoming of two-step procurement--the inability to acknowledge design or technical quality above the specified minimum requirements.

All bidders said Two-Step Formal Advertising is a useful way for the Corps to award contracts. They also favored the integration of design with construction and encouraged this practice, saying it allowed better control and communication. Two bidders suggested that awarding the contract solely on low bid was not an ideal practice because improved quality was not considered. Two other bidders thought the functional specifications were too open; the RFTP could have further qualified what was acceptable or expected. One interpreted a specification as a guideline when, in fact, it was a mandatory requirement. Another did not realize a less elaborate solution would have been acceptable and would have enabled a lower bid to be submitted. While one bidder did suggest some sort of renumeration for the high cost of bidding (all bidders reported the cost of preparing proposals was two to five times the normal cost), the others felt it was merely "the cost of playing the game." All but one indicated they would participate in future two-step procurement.

Construction Documentation

The RFTP did not specify a time when the contractor, after receiving the NTP, was to complete all final construction documentation. In fact, the company was allowed to determine its own timetable for submittals. The RFTP allowed submittals to be phased with construction activity, with up to six submittal stages. The contractor took advantage of this opportunity, submitting construction documentation in three phases: (1) site, (2) foundation, and (3) all remaining documents. Site work began upon completion, review, and approval of the site documents and while foundation documents were being completed. Similarly, foundation work began upon approval of those documents during the review of all remaining documents. The contractor completed and submitted all final construction documentation in approximately 75 calendar days. The District took roughly 2-1/2 weeks to review each of the site development and foundation design submittals and roughly 6 weeks for the remaining documents. The contractor commented that, had phasing documentation with construction not been allowed, the construction would have been delayed approximately 4 months (time between actual construction start to Construction Division's final approval of all documentation). The contractor added that such a major delay in the onset of construction would have necessitated a higher bid price.

The final construction documentation included drawings, specifications, and complete calculations for all engineering disciplines. In addition, a final energy budget for the gymnasium and swimming pool areas was required. All documentation was required to comply with the contractor's step-1 proposal and with criteria in the RFTP. District personnel considered the documentation quality to be as good as a conventionally prepared MCA bid package. The District's Engineering Division evaluated and reviewed all construction documentation for conformance with RFTP criteria. After the contract was awarded,

the review continued; however, the Construction Division had officially approved all documentation.

Construction documentation was speeded because, with two-step procurement, the contractor generates the design and construction documentation. Both the contractor and the Corps indicated that shop drawing development and review is also greatly simplified. Much of the information traditionally required is, in this case, no longer required or can be incorporated directly into working drawings and specifications. The contractor has estimated that some phases of construction would have been delayed up to 2 months had this not been the case. In addition, the use of a preengineered building system has been credited with "considerable" time and cost savings. Little structural design on the contractor's part was necessary, as the building system manufacturer (Armco) conducted the structural analysis and design. Standardized building system details were also used to a great extent.

The RFTP did not specify any minimum or maximum turnaround time for Corps' review and approval of submitted documentation. During this process, the Engineering Division requested that some revisions be made and documents be resubmitted. Overall, the contractor would have preferred a quicker turnaround time for review and approval, and that these arrangements be indicated in the RFTP. Apparently, some disciplines took much more time to review their particular area of documentation than others. However, there were no inordinate delays or problems as a result.

Construction Administration

The RFTP stated that the contractor was to complete the entire facility and have it ready for use within 480 calendar days after the date of receiving the NTP. The contractor acknowledged receipt of the NTP on 14 April 1982, and began site preparation work 1 week later. Within 4 months, practically all foundation work had been completed with structural, slab, and masonry work well underway. Within the next 3 months, the building was enclosed and interior mechanical, electrical, and finish construction was in progress. The facility was opened for beneficial occupancy on 1 April 1983. Construction progressed with very little difficulty from both the Corps' and the contractor's perspectives. Thus, a project expected to take 480 calendar days was completed in approximately 350, 130 calendar days less than normally anticipated.

The Corps' project engineer and the contractor have identified five factors contributing to the faster construction period: (1) making design and construction activities a single responsibility; (2) allowing the contractor to phase submittal of documentation and construction; (3) the contractor was eager to commence construction and to enclose the building before winter arrived; (4) establishing a cooperative working relationship between the District and Area Office and the contractor; (5) using a preengineered building system.

Though the proposed design used a preengineered building system, the contractor is not a preengineered building systems franchised contractor. He could have proposed a conventional construction approach, but he chose a preengineered system because first, the RFTP "encouraged" their use and second,

he previously had found preengineered building systems to save both cost and time over conventional construction. He also had surmised that preengineered building systems would offer the ideal structural design for physical fitness center's open space requirements. The contractor cited the following advantages: (1) components are prefabricated and ready for fast delivery, (2) standardized construction procedures can be used, and (3) only one supplier provides most major building components. Again, the third reason is a major advantage because the contractor can coordinate with and rely on fewer suppliers.

Quality assurance (QA) was handled in the same way as for conventional MCA construction administration. For offsite QA of system and subsystem fabrication, a Certificate of Compliance was required. The Corps' project engineer had little trouble verifying conformance to the RFTP and to the quality level proposed in step 1 and indicated in the construction documents. Verifying compliance often was a simple matter of checking a proprietary style or model number as cited in the contractor's drawings and specifications. However, because the RFTP made extensive reference to industry standards and specifications rather than the usual Corps criteria, Corps field personnel required some time to become familiar with these standards. However, this proved to be no problem, and the Corps' project engineer felt that construction quality was not sacrificed with the two-step procurement.

Payment was made in the usual way. For offsite fabrication not yet installed, the District paid for materials when delivered onsite or when the contractor acquired the title.

Overall, no contractor-initiated change orders were requested, again because the contractor assumes responsibility for generating the design and construction documentation. The Corps issued some change orders upon finding some ambiguities in the RFTP for which the Corps was responsible. Unexpected site conditions also were discovered during construction, and the using agency requested an additional design change after the contract was awarded. The contractor commented that he would have requested change orders for some items had he not been responsible for the design. One example was the concrete masonry wall construction and insulation detailing: once into construction, the contractor found this particular detail less convenient to install than originally anticipated. Although he would have preferred to change this configuration during construction, any modifications (and extra expenses) would have been his responsibility alone. Therefore, since the original detail was satisfactory to the Corps and approved for construction, he did not seek a change order.

The project engineer commented that, for the most part, there was "little difference" in S&A for a two-step construction contract compared to a conventional construction contract. However, he estimated that some time and effort ("approximately 30 percent") were saved in S&A because of less time spent on having to verify QA.

Final construction costs for the facility have not yet been settled. The project engineer has estimated with one claim (still outstanding) that, including all change order costs, the project will cost less than $100,000 (about 4 percent) more than the contractor's original step-2 bid price. This

is within the programmed 5 percent contingency of the construction contract cost.

Building Technology

The physical fitness center was constructed using an Armco preengineered building system. The "industrialized" elements consisted of the preengineered steel superstructure, roof support and roofing, exterior metal wall components, and various architectural trim and accessories. Figure 7 shows the building system components as delivered to the site. Figure 8 shows the preengineered steel superstructure for the facility's gymnasium. It consists of a rigid-frame, multiple-span structural layout. Figure 9 shows the rigid-frame clear span structures for the natatorium. Figure 10 demonstrates the installation of the standing seam roof system, which is aluminized steel panels fastened to Z-purlins with concealed fasteners. Exterior wall panels (Figure 11) were installed over a concrete masonry wainscot, because the concrete masonry provided a more suitable interior finish for this type of facility. Metal liner panels provided the interior surface above the masonry wainscot. Guttering and other accessories are included in the building system.

The remaining construction used conventional materials and methods. Figure 12 shows the interface of concrete masonry wainscot with the preengineered superstructure. Interior construction was mainly concrete masonry partitions and suspended acoustic ceilings when finished ceilings were required. All other finishing, mechanical, plumbing, and electric work were installed by conventional methods.

Close-Out and Occupancy

Close-out procedures for this project were the same as for a conventional construction contract. Overall, it appears everyone is very pleased with the facility's quality and is confident it will serve its function well. The Construction Division and the contractor have maintained an excellent relationship. The contractor commented that he is satisfied with this experience and would be willing to deal with a Corps two-step acquisition again. The Corps project manager called this project "an outstanding success," commenting that this was one of the best facilities of its type he has seen.

The installation's facility engineer and the facility's manager have identified some problems relating to occupancy, equipment, design details, and finish materials. Apparently, the new facility's usage is considerably greater than expected and thus it is often overcrowded. For example, the men's whirlpool filtering equipment had to be replaced after it proved inadequate to handle the load. Note, however, that the original equipment the contractor installed did meet the criteria specified in the RFTP. In addition, the HVAC system apparently has not yet proved totally satisfactory. The problem has not been diagnosed, but it is believed also to relate to the facility's heavy traffic. A contractor-generated construction detail for the interface between masonry wall construction and prefabricated wall panels in the natatorium has resulted in a condensation problem. The project engineer has identified this as a design deficiency. The contractor has acknowledged

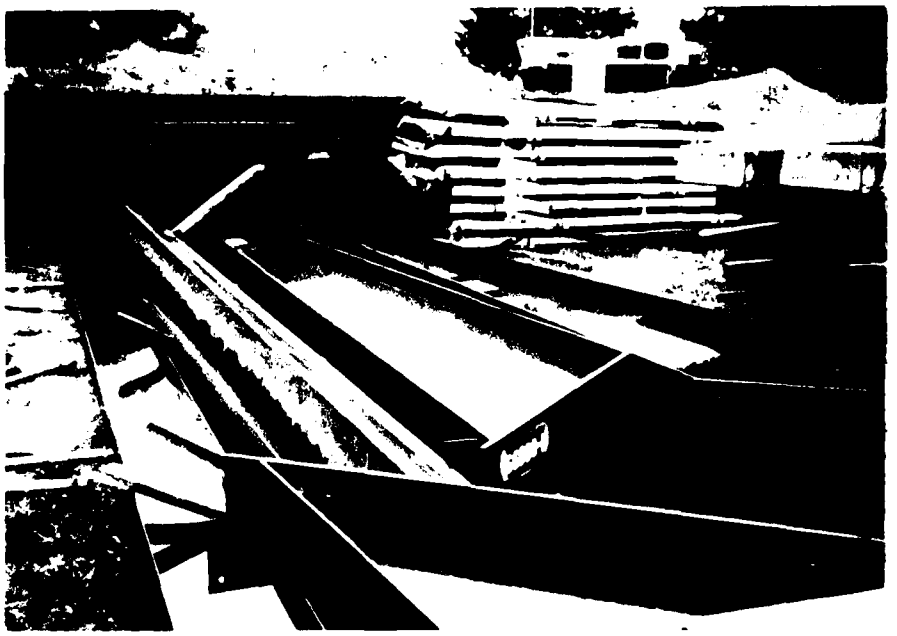


Figure 7. Preengineered steel superstructure as delivered--Fort Benjamin Harrison project.

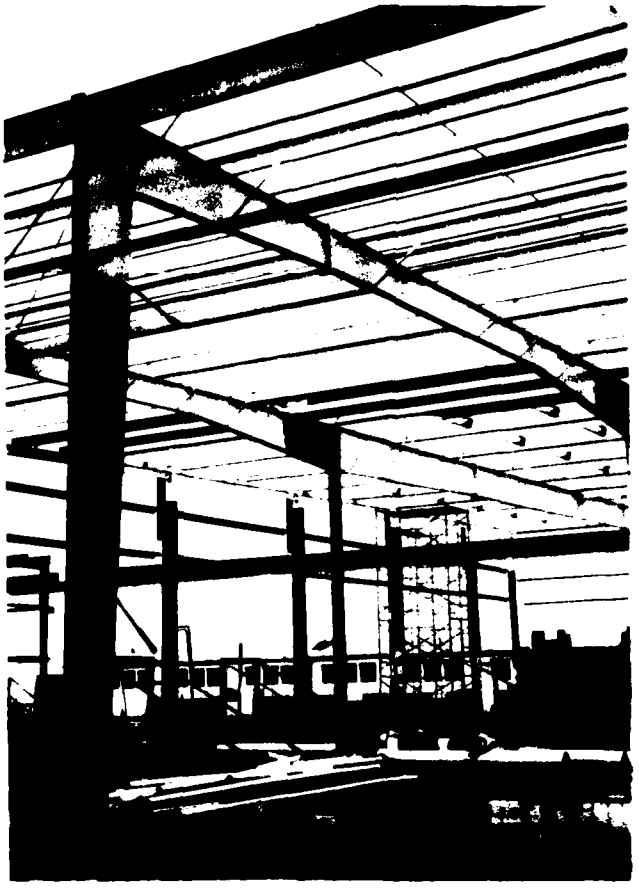


Figure 8. Preengineered steel superstructure for gymnasium--Fort Benjamin Harrison project.

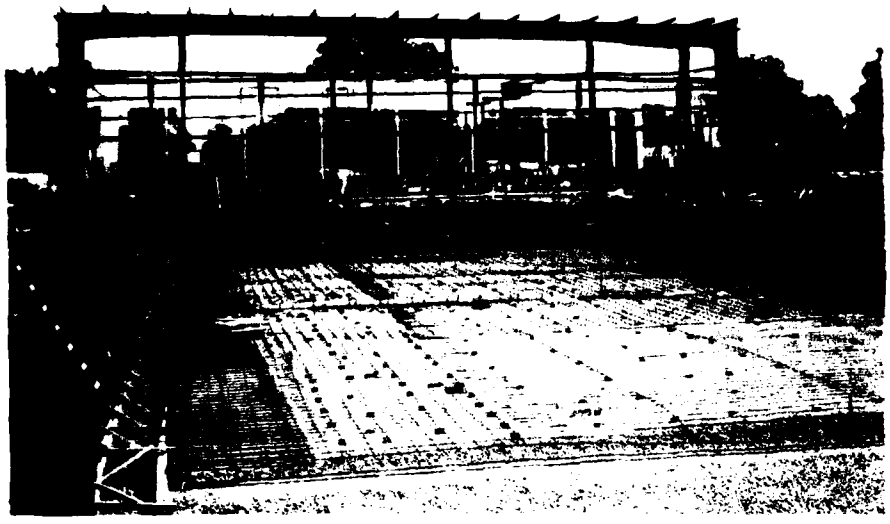


Figure 9. Rigid-frame, clear-span structure for natatorium--Fort Benjamin Harrison.

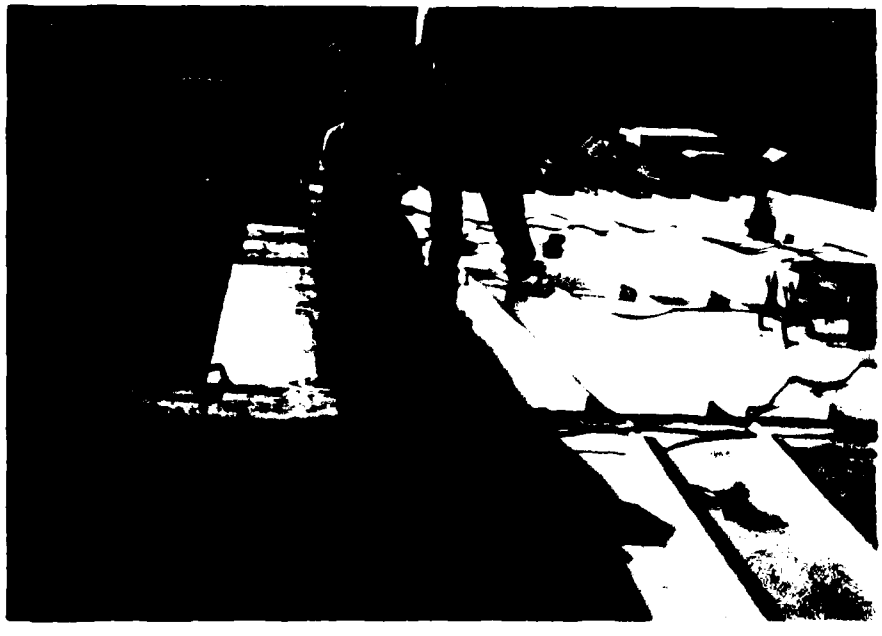


Figure 10. Installation of standing seam roof--Fort Benjamin Harrison.

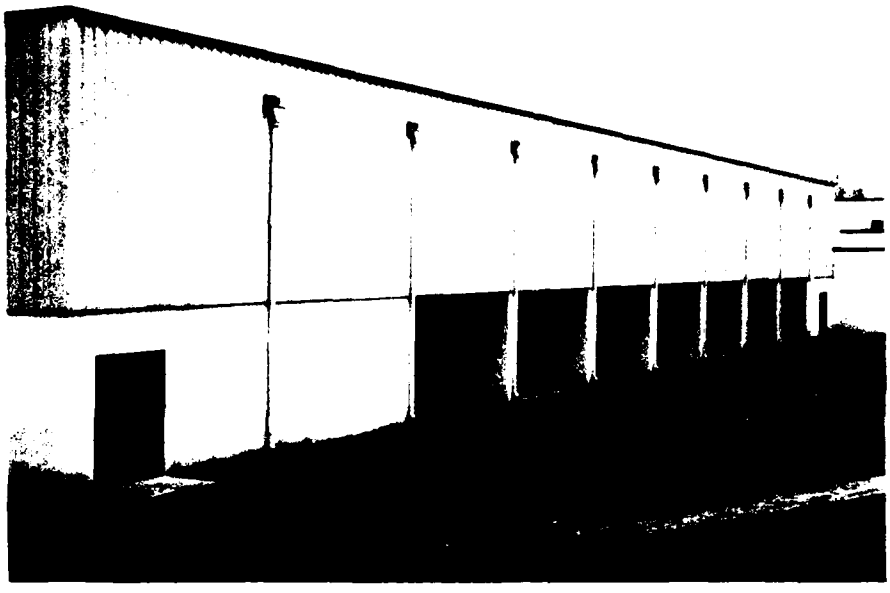


Figure 11. Exterior wall panels--Fort Benjamin Harrison project.

Figure 12. Concrete masonry wainscot/preengineered superstructure interface--Fort Benjamin Harrison project.

ponsibility for the detail and is correcting the problem. Moreover, the ility engineer has identified some finishes that have proven to require e maintenance than desirable. He has commented that this is a lesson rned for specification, evaluation, and approval of construction in future -step procurements. Figure 13 shows the completed facility's exterior; ures 14 and 15 show the interiors of the gynasium and natatorium, respec-ely.

clusions

Time was saved throughout all areas of this project. First, the RFTP was pleted in considerably less time than would have been required for a con-tional design, partly because an existing plan was used but also because of RFTP's simplified composition. The relatively short RFTP development time n necessitated early advertisement, as discussed. Proposal development e, therefore, did not impose any time handicap on the project compared to a ventional MCA project schedule. Seasonal considerations indicated no antage in accelerating the proposal evaluation, bidding, and contract award ivities. Although these activities took more time than conventional ding and award, they were of no disadvantage to the project. Time savings this project can be attributed to both preengineering technology and the curement method. Use of a preengineering building system has expedited struction documentation, review and approval, and actual construction. In ition, two-step procurement allows construction documentation to be phased h actual construction, thus enabling construction activities to begin much ner after contract award. Figure 16 shows the project events by month.

Money was also saved in all areas of this project. Cost to the Govern-t for "design" (RFTP preparation) was considerably less than for conven-nal design services. Total design costs associated with RFTP preparation, posal development, and final construction documentation was only slightly e than likely would have been spent on conventional design.

Construction savings also were realized by using preengineered building tems and the two-step procurement process. The contractor indicated that a engineered metal building system was "ideal" for this type of facility due the efficiency and economy of structural arrangement offered. This conten-n is reflected in the bid results. The contractor also cited features of a ign/build approach as contributing to lower construction costs: (1) design l construction are combined into a single responsibility so that the design evaluated thoroughly for economic efficiency, and (2) a contractor familiar h the design is at lower risk and can reduce that contingency factor in the . The time savings cited above also saved money, since a proposer's bid ce will be affected by the length of the construction period anticipated the project. The contractor for this project had overhead costs of ghly $1000 per week just for time spent onsite. If shortened construction iod can be anticipated, any savings estimated as a result will be reflected a lower bid price. In addition, two-step procurement has been shown to atly reduce costly modifications to the construction contract. The con-ctor generates the final design and construction documentation, thus orbing the cost of any errors or oversights that may occur. The Corps' ject engineer has also suggested that savings in construction S&A costs e realized as a result of the procurement method. Figure 17 is a graphic parison of the Government Estimate versus actual construction costs.

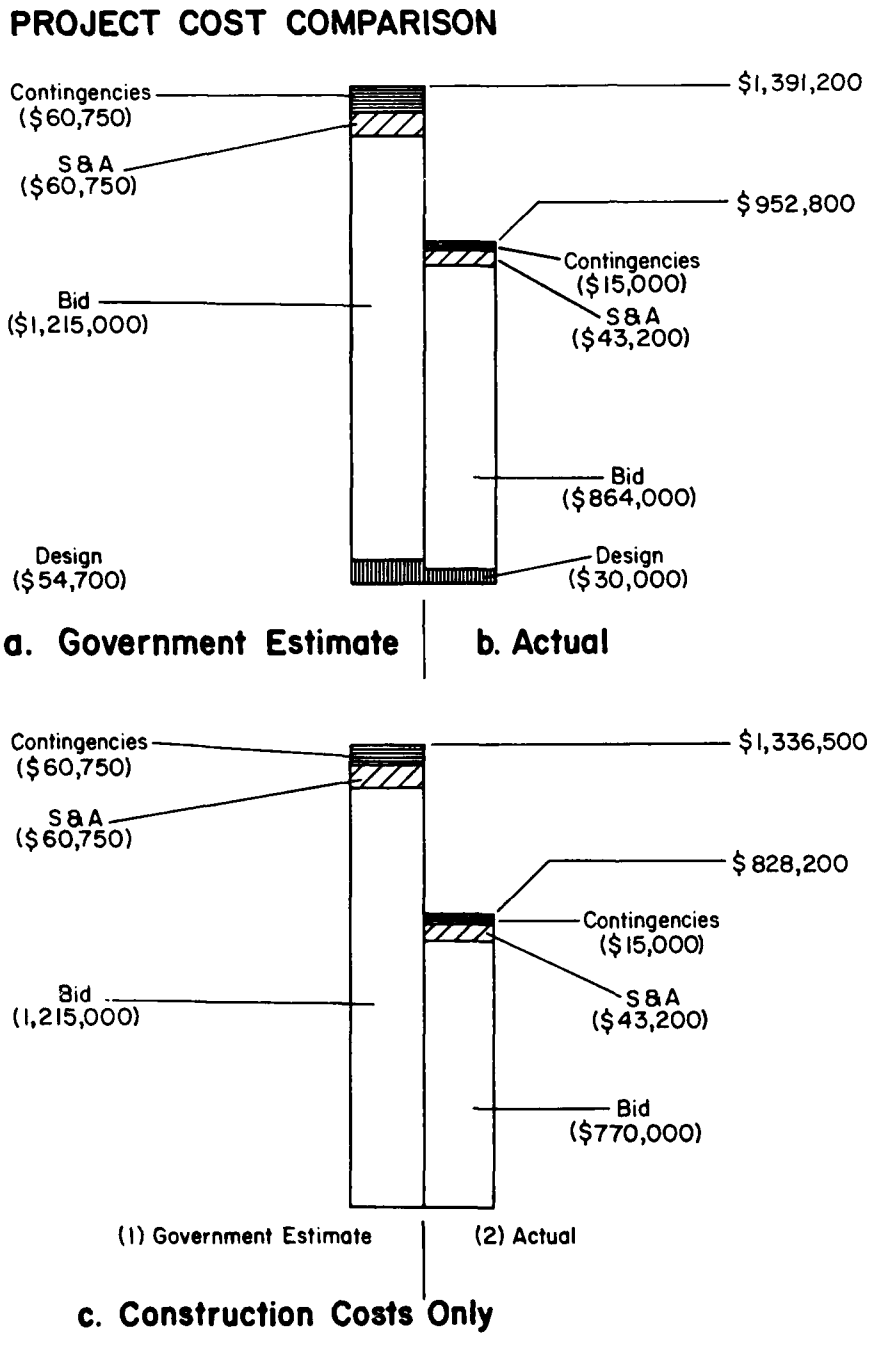
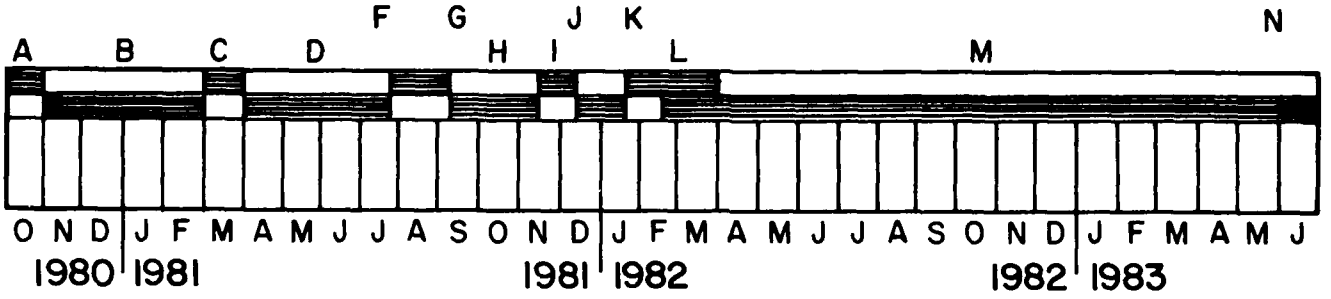


Figure 20. Cost comparison--Fort Stewart project.

PROJECT EVENTS



Project Events Key:

A - A/E Contracted

B - Design Concept Development

C - Design Concept Review/Approval

D - Prepare RFTP

E - RFTP Review/Approval

F - Advertise RFTP

G - Step 1/Technical Proposals Due

H - Step 1/Technical Proposal Evaluation

I - Invitiations for Bid (IFB)

J - Step 2/Bids Due

K - Contract Award

L - Completion of Construction Documentation

M - Construction

N - Beneficial Occupancy

Figure 19. Project events by month--Fort Stewart.

User reaction also has been positive though there have been some problems th the solar system. The cause for this has not yet been diagnosed. Figure shows the completed facility.

nclusions

With this project, the contractor did not anticipate the actual construc- on completion time to be shorter than that specified in the RFTP (300 calen- r days). The contractor also proposed a conventional construction design d not an industrialized or preengineered building system (he had had no pre- ous experience with these systems). The fact that a conventional design oved more economical for this project reinforces the validity of Two-Step rmal Advertising. The longer construction time (480 versus 300 days) did t reflect problems in the procurement procedure. Figure 19 shows the proc- ct time schedule by month for case study 3.

Despite the mechanical subcontractor's default and long delays in con- ruction (approximately 180 calendar days), the project still closed out thin 1.5 percent of the contractor's original step-2 bid price. Thus, two- ep procurement has proven to greatly reduce the cost of modifications to the nstruction contract. In addition to these savings, the Construction Divi- on expects more money to be saved once the procurement methodology is well derstood by all parties. Figure 20 is a graphic comparison of Government timates versus actual construction costs.

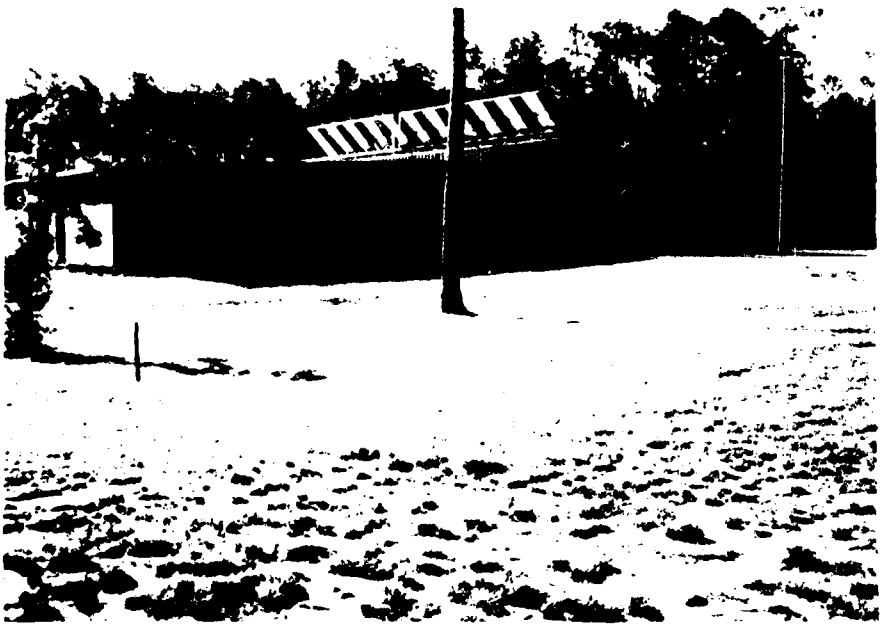


Figure 18. Completed facility--Fort Stewart project.

of looking for the products, brand names, and model numbers that the contractor had specified and that had been approved. The project engineer felt that QA was not sacrificed as a result of using two-step procurement.

Payment proceeded in the usual way. For fabrication not yet installed, the District paid for materials onsite or when the contractor acquired the title.

No contractor-initiated change orders were requested throughout this project. Again, this is attributed to the contractor's assumption of responsibility for generating the design and construction documentation. The only change orders submitted were initiated by the District when unexpected site conditions were discovered during construction and when the using agency requested minor design changes after contract award. The contractor commented that the two-step methodology should enable the Corps to avoid many potential disputes when the contractor generates the design and construction documentation. He also suggested that, with conventional procurements, the contractor has many opportunities to take advantage of situations resulting in disputes and claims.

Overall, the project engineer stated that two-step construction contracts require less time and effort for S&A than conventional contracts. This is again attributed to the fact that the contractor is familiar with the design and construction requirements and is responsible for any problems resulting from them. In addition, checking QA compliance was simply a matter of looking for brand names and model numbers. The project engineer anticipated even more savings once the method is well understood by all parties involved. The problems resulting from the mechanical subcontractor's default were considered unrelated to the two-step procurement process and could have occurred regardless of the procurement method used.

The final construction cost for the facility will be about $877,372 (with one claim still outstanding valued at approximately $5300). This figure is about $13,400, or 1.5 percent over the contractor's step-2 bid price ($864,000), which is well below the programmed amount for contingencies of 5 percent.

Building Technology

The fire station was constructed using conventional materials and methods with steel frame, masonry walls, and built-up roofing. There were no unique features of construction technology for this project related to industrialized building systems.

Close-Out and Occupancy

Close-out procedures for this project were administered the same as for conventional construction contracts. Overall, everyone appears pleased with the the facility's quality and the District's area engineer is confident the facility will serve its purpose. The contractor said he would be willing to deal with the Corps again and, as a result of this experience, expects his company would be able to realize even more savings in future two-step projects, which would be reflected in the bid price.

preparation). Overall, the Engineering and Construction Division found that two-step procurement brought some savings in the time and effort required to review and approve the construction documents. In addition, Division personnel stated more savings could be expected once everyone involved became more familiar with the procurement method.

Construction Administration

The RFTP stated that the contractor was to complete the entire facility and have it ready for use within 300 calendar days (approximately 10 months) after the date of NTP receipt. The NTP was issued 11 February, and site preparation began about one week later. Foundation work was started in mid-April, and within 6 weeks (late May) the building was approximately 35 percent complete and more than a month ahead of schedule. Within another 10 weeks (early August), the building was 50 percent complete with all foundation, slab, masonry, and steel work completed. At this point, however, work progress began to slow until soon, the project fell behind schedule. The main reason for this was the mechanical subcontractor's default. By September, all roofing and exterior sheet metal work was completed, the building was enclosed, and interior electrical and finish construction were started to the extent possible. Construction was now 3 weeks behind schedule. The subcontractor's default required redesigns and resubmittals for the mechanical system. Other construction that depended on the completion of the mechanical system was likewise set back. On 30 June 1983, the facility was ready for beneficial occupancy, so that a project estimated to take 300 calendar days actually required 480.

The Corps project engineer and the contractor attributed most of the delay to a combination of bad weather and the mechanical subcontractor's untimely default after contract award and onset of construction. Bad weather accounted for approximately 30 days of delay.

With the subcontractor's default, the general contractor not only had difficulty replacing him, but also in delivering the exact same equipment that this subcontractor had specified, and on which the general contractor had based his proposal and bid. Furthermore, the general contractor had developed his definitive mechanical design around this equipment, and that design had been approved for construction. In some instances, the Construction Division allowed the general contractor to install equipment other than that originally specified and approved, provided this equipment also satisfied RFTP criteria. To do this, the contractor was required to change and resubmit documentation for review and approval, delaying the project schedule further. In other cases, the Construction Division would not allow equipment substitutions for items originally specified and approved. Therefore, some equipment orders had to be delayed until this issue could be resolved--another setback for the schedule.

QA was handled in the same way as for conventional MCA construction administration. The Construction Division had little trouble verifying that the quality level specified in the RFTP and proposed in step 1 was maintained throughout the construction process. Checking compliance was simply a matter

Construction Documentation

The RFTP required the winning bidder to submit for review and approval all final construction documentation within the first 35 calendar days of the NTP. However, the District decided construction need not be hurried for this facility so it required that all documentation be completed and approved before work began. However, site documentation and construction were allowed to begin before the approval of all other construction documentation. The contractor stated that allowing only 35 calendar days to complete all documentation was very demanding and that 90 days would have been more suitable.

Final construction documentation included construction drawings, specifications, and calculations for structural, mechanical, electrical, and outside utility work. All documentation was required to comply with the contractor's step-1 proposal and with the design and technical criteria in the RFTP; in addition, it had to contain enough detail to analyze and determine the quality of materials and workmanship required. The District Engineering Division reviewed all technical documentation before the contract was awarded. Afterward, this review continued, but the Division had officially approved all documentation.

Construction documentation was again speeded because the contractor generated it as well as the design. The Engineering Division noted that the contractor's construction documentation was somewhat less detailed than normally expected in a traditional AE-prepared MCA bid package, but that they were as detailed as expected for any commercially prepared bid package. No extraordinary problems were reported as resulting from the working drawings. The Corps project engineer added that the specifications were more "supplier-oriented."

The RFTP had indicated that the contractor's own design staff was to review and certify that all shop drawings conformed to the construction drawings, the step-1 proposal, and the RFTP. The District would not be involved in shop drawing review but was to delegate this responsibility to the contractor, with the District requiring copies of the shop drawings for record only. As a result, shop drawing development and review were simplified greatly. The contractor commented that he could cut back on shop drawings, saving several months over the Corps' usual shop drawing submittal/review/approval process.

The RFTP stated that the Corps would be allowed 14 calendar days to review the contractor's documentation submittals, but no maximum time was indicated for District approval of the documents. However, the RFTP did state that for every day review/approval exceeded 14 days, the completion dates were to be extended the same. The Corps project engineer said that 14 days was too demanding and that 21 to 30 days to review the documentation would have been more reasonable from the Corps' standpoint.

Both the project engineer and the contractor suggested that the RFTP should provide more guidance, primarily in describing the submittal/review/approval process, times, and personnel involved. After initial review, the Engineering Division requested that some revisions be made with those documents resubmitted. However, the contractor was allowed to begin work on documentatation phases that had been approved (i.e., site and foundation

Table 3

Cost Comparison Summary: Fort Stewart

a.	Government Estimate		
(1)	Design*		$ 54,700
(2)	Bid**		1,215,000
(3)	Supervision and Administration (S&A)		60,750
(4)	Construction Contingencies***		60,750
(5)	Total Estimated, Conventional Design and Construction		$1,391,200
b.	Actual		
(1)	Design (RFTP preparation)		$ 30,600
(2)	Bid (design and construction)		864,000
(3)	S&A+	less than	43,200
(4)	Construction Contingencies	less than	15,000
(5)	Total Actual, Design and Construction	less than	$ 952,800
	= 32% less than conventional		
c.	Construction Costs Only		
(1)	Government Estimate		
	Contract Cost		$1,215,000
	S&A		60,750
	Contingencies		60,750
	Total Construction Cost		$1,336,500
(2)	Actual		
	Construction Cost‡		$770,000
	S&A	less than	43,200
	Contingencies		15,000
	Total Construction Cost	less than	$ 828,200
(3)	Construction Cost Difference	more than	$ 508,300
	= 38% less than conventional		

*Conventional design estimated at approximately 4.5 percent of the conventional construction estimate.
**Government Estimate for construction, based on conventional.
***Five percent of Government Estimate.
+Five percent of bid amount.
‡Contract amount minus contractor's AE design costs.

as the RFTP indicated to proposers that progress to step 2 bidding was contingent upon receipt of construction funding and would not begin until then.

Besides advertising the project in the CBD, the notice was mailed to the District's standard bidder's list, which consisted mostly of general contractors with whom the District had contracted or who previously had expressed interest in Corps' work. No special notification was sent to building systems or design/build contractors. Approximately 7 weeks was allowed for proposal preparation and submittal.

Proposal contents were specified in the RFTP. Essentially, step-1 submittals were to include a site plan, floor plan, elevations, building cross section, wall and roof sections, outline specifications, manufacturers' literature, and measures to prevent environmental pollution during construction. Appendix B shows the winning proposer's drawings.

Two proposals were received--one using conventional steel frame and masonry construction, and the other proposal representing a preengineered metal building system. The District evaluated the proposals in 1 day, and both were judged to be acceptable as submitted.

The District invited bids from both proposers. C&G Construction Co., Inc., Augusta, GA, was awarded the contract after submitting the low bid of $864,000--29 percent below the Government Estimate of $1,215,000. Saussy Engineering, Inc., Savannah, GA, was the AE Firm for C&G. Table 3 provides a detailed cost comparison. The other proposal, a preengineered metal building system, was bid at $1,215,000--the exact figure stated in the RFTP as the maximum contract award amount. The losing bidder stated that, had he realized no credit was given for a more elaborate design, he would have developed and bid his proposal accordingly. It should be noted, however, that the RFTP stated very clearly that this was a competitive bid procurement and in no way promised any credit for design and technical quality above the minimum requirements specified. Again, this situation demonstrates a shortcoming of two-step procurement--the inability to acknowledge quality above the specified minimum requirements. It also reinforces the need for clear communication in the RFTP.

Overall, neither proposer indicated problems with understanding and conforming to the specifications. Performance specifying also created no problems for either. Both proposers thought that allowing suitable industry standards and specifications to replace military criteria would enable the contractor to lower construction costs and should be permitted more often. In addition, both favored the integration of design and construction activities into one responsibility and suggested this allowed better project control. In all, they stated that Two-Step Formal Advertising would yield the Corps lower construction costs with shorter building delivery times. Both proposers commented that even though their cost of bidding was two to three times normally spent, they did not see this as an unreasonable expense for this type procurement.

design, floor layouts, preliminary cost estimate, and outline specifications. The District reported concept design completion accordingly.

RFTP Development

A final RFTP was advertised consisting of an introduction, special provisions, outline specifications worksheet and proposal formwork to be completed and submitted by the proposer, project development requirements, site survey and test data, and drawings.

The RFTP introduction described the project briefly, discussed the two-step procurement process, and gave requirements for developing and submitting a proposal, submittal material, evaluation criteria, and contracting provisions. The contract requirements and special provisions were standard construction contract items that applied directly to the bidding process (step 2) only, but were included in the RFTP as information to proposers. An outline specifications worksheet was included in the RFTP to be completed by the proposer and included with all other proposal submittals. The worksheet was organized according to CSI 16 Division format with an abbreviated line-item listing of materials and subsystems that apply to each Division. The proposer was to indicate a response to those items in the technical proposal. The project development requirements included a functional description of the facility, existing site conditions and requirements, design criteria and specifications for the building systems and components consisting of both functional and technical requirements, and references to industry and military standards and specifications.

The drawings included were those of a similar facility at Fort Riley, KS. They were provided for information only and to display the basic design arrangement required for the project. Proposing agencies were given the latitude to adjust dimensions and details to suit their own construction solutions, but were to adhere to the basic design layout in the drawings. Appendix A is an expanded outline of the RFTP contents.

The RFTP made no statement encouraging participation by any particular type of contractor or use of any certain construction technique. Thus, any type of construction could be proposed.

Approximately 9 months elapsed from the initiation of design to RFTP advertisement. The District reported no difficulties or unusual situations with the RFTP's development.

Bidding

RFTP advertisement for this project also created a situation not normally found in a conventional MCA project: the project was advertised before construction funding was authorized. In this case, the RFTP was completed more than 2 months before new fiscal year on 1 October (Budget Year). Rather than delay the project, the District requested authority from the South Atlanta Division to advertise step 1 upon completion of the RFTP. For the same reasons cited in Chapter 4, the Division granted authority to do so, as long

5 FORT STEWART FIRE STATION

The Fire Station at Fort Stewart, GA, was built to house the Fire Prevention and Rescue Team of the 24th Infantry Division. With approximately 9500 sq ft, this single-story facility provides kitchen, dining, dayroom/classroom, sleeping, administrative, and vehicle storage spaces. The Corps' Savannah District administered design and construction.

Predesign Activities

OCE issued Engineering Instructions for the project in the usual way. Again, they included a discussion of industrialized building systems and directions to initiate a two-step procurement. The Engineering Instructions also indicated that, if the District were to contract for AE services, selection criteria should include proficiency with performance specifying and experience with industrialized building systems projects. (The District contracted with Ingram, Paris, and Gregory, Atlanta, GA, to develop the concept and prepare the RFTP; the AE's fee for this work was around $30,000.) The instructions made no other reference to this being a "pilot project" or any sort of special case. An Army Section project manager was assigned to the project as usual. In previous experience with design/build procurements, the District has used both performance specifications and Two-Step Formal Advertising several times, mostly on Nonappropriated Fund buildings.

Concept Design

An existing plan for a fire station at Fort Riley, KS, was used as the basis for the facility's design. It was intended that proposers adhere to the layout and functional relationships of this plan, but offer their own construction type, dimensions, and details. The installation did, however, want to maintain a brick exterior to match adjacent construction. In addition, the building's mechanical system was to incorporate a complete, active solar system to provide energy for domestic water heating and building space heating.

The Savannah District did not use descriptive military guide specifications that would need converting into equivalent performance specifications; instead, the AE firm was instructed to cite industry standards and performance criteria. However, military standards were to be used for critical design elements such as wind-loading and seismic design. Mandatory construction type and definitive dimensions were not given, since the District was specifying only functional requirements. Because this was to be a performance-based procurement, the District and Division judged that existing descriptive construction criteria did not apply to this type procurement; South Atlanta Division concurred. (Again, FARs allow industry standards and specifications to replace military criteria when suitable standards exist.)

As a two-step procurement, MCA design status reporting differed from a conventional MCA project. Conventional concept design is defined as "35 percent design completion," whereas comparable progress toward RFTP completion represents a considerably smaller percentage. In the Engineering Instructions, OCE defined 35 percent completion as preliminary site and utilities

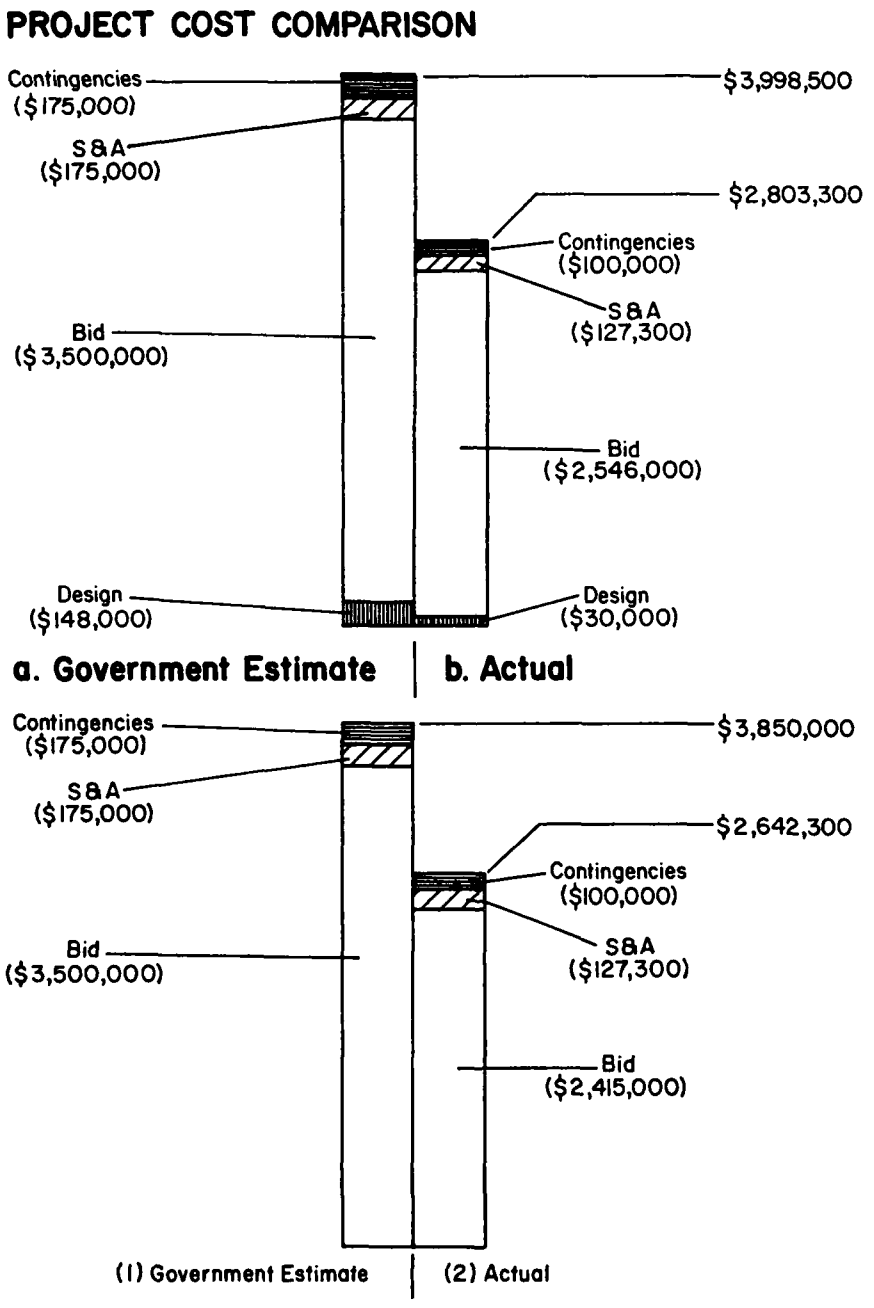
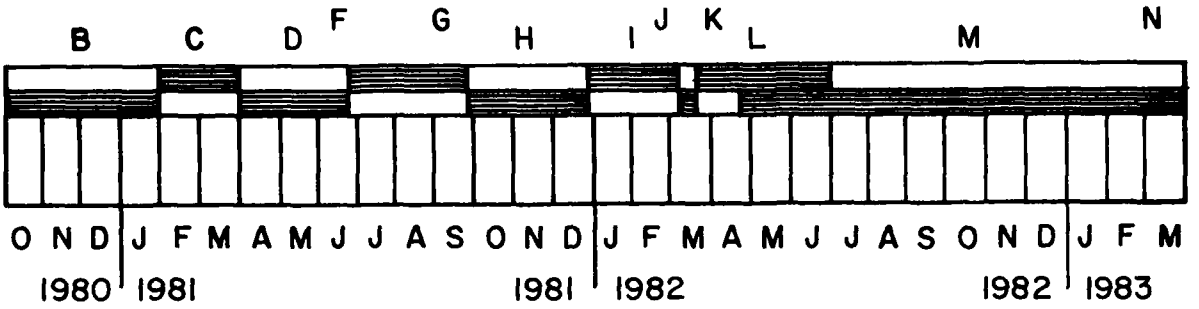


Figure 17. Cost comparison--Fort Benjamin Harrison.

PROJECT EVENTS



Project Events Key:

A - A/E Contracted

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C - Design Concept Review/Approval

D - Prepare RFTP

E - RFTP Review/Approval

F - Advertise RFTP

G - Step 1/Technical Proposals Due

H - Step 1/Technical Proposal Evaluation

I - Invitiations for Bid (IFB)

J - Step 2/Bids Due

K - Contract Award

L - Completion of Construction Documentation

M - Construction

N - Beneficial Occupancy

Figure 16. Project events by month--Fort Benjamin Harrison.

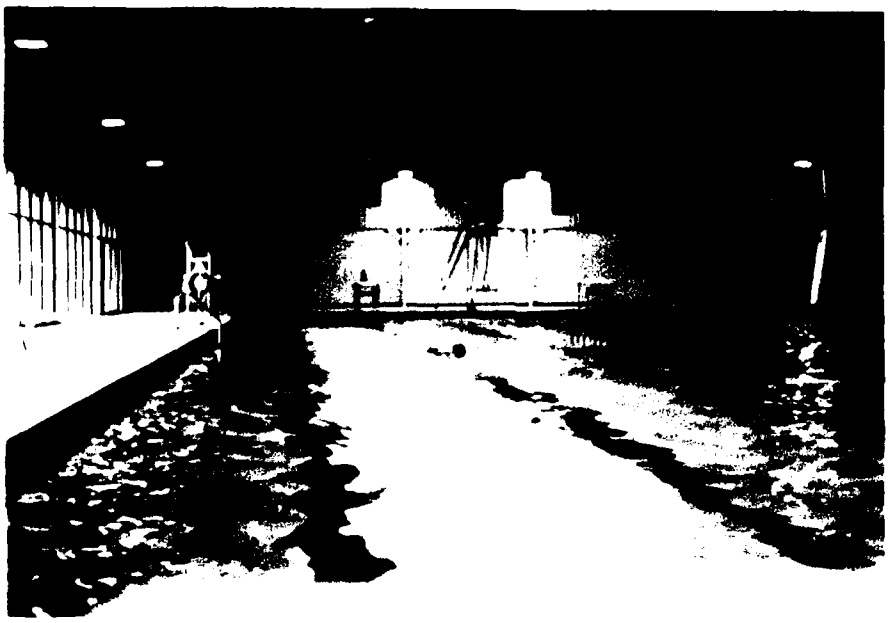

Figure 15. Natatorium interior--Fort Benjamin Harrison.

Corps personnel involved with this project remarked that the quality of design, construction documents, and construction were at least as good as found in any conventional MCA project. At no time did the Corps feel a loss of control over project quality. They cited proposal evaluation, approval of construction documents, and normal QA procedures as insuring quality throughout the project. The Corps' project engineer did express concern regarding the adequacy of some swimming pool filters. It must be noted, however, that the equipment met the criteria specified in the RFTP, so this issue is with the specifications, not with design or construction quality.

Corps personnel indicated that overall administrative effort devoted to this project was less than normally expected with conventional MCA projects. The RFTP's simplified composition required less administrative effort in the design stage. In addition, Corps personnel reported no difficulties or extraordinary efforts in proposal evaluation or construction document review and approval. Finally, construction S&A efforts were reduced due to simplified QA.

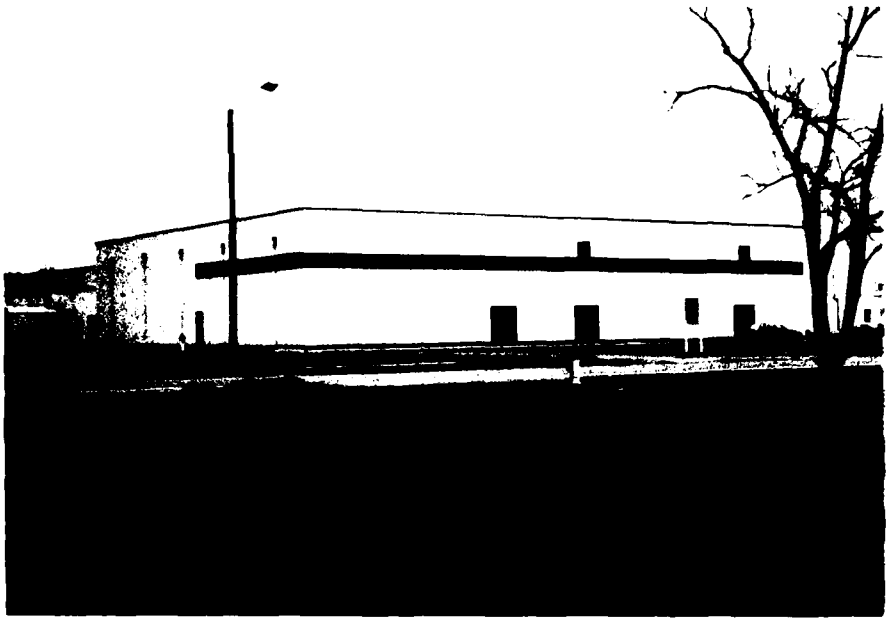

Figure 13. Completed project--Fort Benjamin Harrison.

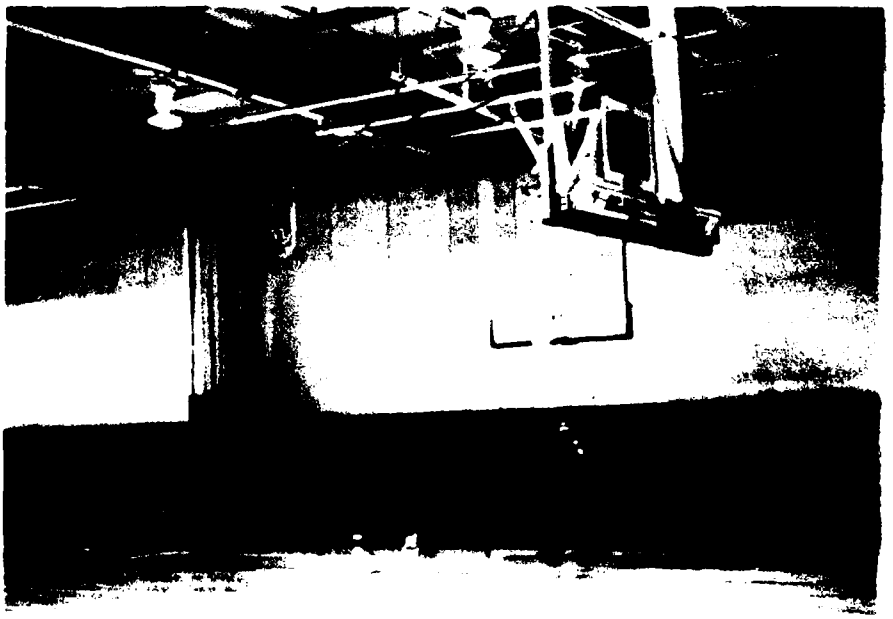

Figure 14. Gymnasium interior--Fort Benjamin Harrison.

6 SUMMARY OF FINDINGS

General--Pilot Project Program

1. The pilot project program achieved positive results in terms of cost, time, and quality. Overall project costs were 28 to 32 percent below estimated conventional cost. Construction time savings of 25 and 50 percent were realized with two of the three projects. Although the third project took considerably longer to close out than estimated, the delays were not related to either the two-step procurement approach or use of industrialized building systems and could occur with any construction project. Both facility design and construction quality for all three projects were acknowledged to be at least as good as normally expected in a conventional MCA project.

2. Industrialized, or preengineered, building systems proved more cost-effective for two of the facilities, whereas conventional construction proved more economical for the third. These results, although not anticipated, do not undermine the economic potential of industrialized building systems. Rather, they reinforce the validity of the two-step procurement approach as a vehicle to achieve the construction solution best suited to the specific application.

3. All three projects were executed successfully as "mainstream" MCA projects--no special treatment was given them as research projects. They were executed by the local District within existing regulatory and procedural environments. Any adjustments in standard activities or procedures were initiated and approved within the usual Corps channels. Although none of the three projects were completely without problems, every problem was resolved in a fairly routine way. Previous experience with two-step procurement proved helpful in avoiding complications.

4. The pilot project program achieved positive results despite an almost random selection of building types and geographic locations. Neither OCE nor USA-CERL selected facilities guaranteed for success. The program's results reinforce the conclusion that industrialized building systems and a design/build procurement method are more flexible and widely available than originally anticipated and represent an opportunity for greater use than had been forecast.

Procurement Method

5. Two-Step Formal Advertising effectively allows industrialized building systems to compete on an equal basis with conventional construction in building procurements. Both construction approaches were proposed and both were evaluated as acceptable solutions in each of the three projects. The most advantageous solution emerged in each case.

6. There was great diversity in design and construction approaches proposed for the three projects. For any one project, no two proposals could be called similar. When given the opportunity, proposing agencies showed considerable creativity and variety in design solutions. Even when design configurations were fixed, proposals varied in structural approaches, material

use, and construction details. This diversity indicates that, for a given project, there is no single "best" design and construction solution--especially when dissimilar designs are developed from the same criteria and specifications. It further indicates that the Corps can benefit from competition among designs and construction methods as well as bidding competition.

7. Advantages in cost, time, and construction administration were achieved by integrating design and construction activities within a single responsibility. The primary objective of contractor-generated design (in two-step procurement) will be economy, with contractors looking for every possible way to make their proposals cost-efficient. (Note, however, that for this reason, the RFTP must express the minimum design and technical performance acceptable because that is exactly what will be proposed.) Contractors have also indicated that their risk is reduced when they are involved in the design. Since contractors will be familiar with the proposed design and construction methods, they can more accurately anticipate time and material costs. The contractors' confidence in their estimates will ultimately be reflected in lower bid prices. Transferring design and construction documentation responsibilities from the Corps to the contractor also results in the contractor's handling areas that traditionally held potential for dispute and contract modification during construction. With the contractor generating the final design and documentation, the Corps does not have to assume responsibility for the cost of any errors or oversights that may occur. The result is that contractor-initiated cost modifications to the contract are eliminated.

8. If the opportunity for phasing documentation and beginning construction is expressed in the RFTP, the contractor can estimate a shortened overall construction period and, therefore, a reduction in overhead costs. Unlike a traditional procurement, the two-step method allows some phases of construction to begin while documentation of others is being completed. As a result, any time savings anticipated will be reflected in a lower bid price. However, the Corps must also recognize its' responsibility to the contractor and provide a quick turnaround when reviewing and approving the construction documentation submittals, as indicated in the RFTP. Provisions and schedules for review and approval must be established within the District's manpower and time capabilities and constraints. However, delays in review and approval not only delay construction, but also the ordering of materials, which seriously burden the contractors' overhead and schedule. If the District cannot reasonably adhere to such a schedule, then phasing of documentation and construction should be avoided.

9. Integrating design, construction documentation, and construction under contractor responsibility did not compromise overall quality for the three pilot projects. In fact, contractors have expressed more concern for delivering a quality product than they might otherwise because they generated the designs. The Districts' Engineering and Construction Divisions are pleased with the facilities' quality as are the installation facility engineers and the facility users.

10. Because contract award for Two-Step Formal Advertising is based on the lowest bid acceptable proposal, no credit can be given to proposals showing quality in excess of the specified minimums, even though the overall cost/quality balance may indicate greater value to the Government. This situation was especially evident in proposals for the physical fitness center.

Although the winning proposal was an entirely satisfactory design and construction solution, others had exceptional design qualities and were still bid well within budget. The inability to take advantage of this potential is considered to be a drawback to two-step procurement and would suggest wider use of one-step procurement when design, technical qualities, and life-cycle cost, as well as bid price, can be factored into the contract award structure. One-step "turnkey" contracting is the standard method used in the acquisition of Army Family Housing.

11. Although Two-Step Formal Advertising is not a new procurement method, its application to Military Construction is by no means standard or widespread. Some Corps Districts have had no previous experience with two-step procurement in MCA; other Districts are experienced and capable in two-step procurement, but use this method infrequently. Thus, the Corps is not as familiar with this method as with the traditional design-bid-build procedure.

12. The two-step procurement approach is compatible with current regulations and can be carried out within current practices. However, adjustments must be made to insure its best use. Compared to the Corps standard design-bid-build process, two-step procurement involves some different issues requiring certain adjustments. These include clarifying a District's authority to initiate a two-step project, concept development and design progress reporting, RFTP composition, early advertisement for step-1 proposals, review and approval of contractor-developed construction documents, and the phasing of construction documentation with construction activities. Although none of these issues presented any real obstacles to any of the three projects, they had to be resolved for efficient project execution.

13. Virtually all proposing firms involved in the three pilot projects (losers as well as winners) found the two-step procurement approach to be an effective, economical method for the Corps to acquire facilities, and most said they would participate in similar procurements in the future. These firms cited the integration of design and construction responsibilities and the opportunity to propose their own designs and construction techniques as the primary advantages to two-step procurement. Potential for time savings and smoother construction administration were associated benefits. The only major objection concerned the low-bid award basis, with losing bidders contending that their higher bids were the result of better quality proposals and that improved quality should be considered in contract award.

14. The cost of developing proposals with no guarantee of contract award appeared not to discourage participation in two-step procurements. Proposers acknowledged that preparing proposals cost up to five times what they would spend on a conventional bid preparation. Although no contractor was enthusiastic about additional expenses, none felt this was unfair as long as the effort was not excessive and the proposal was examined carefully during proposal evaluation. The general consensus was that this was an acceptable cost of doing business for this type procurement.

15. Common stereotypes of two-step procurement are that it requires more time and effort on the Corps' part than traditional bidding and that the Corps loses control over design and quality; this proved not to be true in the pilot project program. None of the three pilot projects had disadvantages in terms of overall time or administrative effort compared to the conventional MCA

process. Although proposal evaluation is an additional task requiring major effort, other areas of the projects required less administrative effort. When a District reported devoting more time and effort to a particular task than typical in a conventional procurement, this was attributed to inexperience, and such efforts would be expected to decline for subsequent projects. At no time did the Corps perceive a loss of control over the projects' design and construction qualities. When the user required a definitive design or configuration, it was included in the RFTP. The Corps administered construction quality control as it would in a conventional MCA project and judged construction quality to be as good as usual. The facilities' users are also satisfied with the new buildings.

Industrialized Building Systems

16. Preengineered building systems allowed significant cost savings over conventional construction methods in two of the three pilot projects. These savings are evident by comparisons with Government estimates for conventional construction and with bids in the same procurement. Furthermore, it must be noted that winning contractors proposed preengineered building systems by choice, recognizing that such an approach could give them a competitive advantage in each procurement. Advantages cited were (a) prefabrication and fast delivery, (b) standardization in construction procedures and simplified erection, and (c) single-source supply for most major building components.

17. Preengineered building systems are suitable for permanent MCA facilities and provide the functional and architectural qualities required for these applications. These systems are adaptable in arrangement, building form, and use of materials to respond to a wide range of specific facility requirements. Preengineered building systems also met all specified construction criteria of the facilities in which they were used; the stereotype of "tin shed" is obsolete.

18. Preengineered building systems along with their design and construction services were used in proposals for all three pilot projects, even with the diversity in building type and geographic location. This suggests a wider range of applicability and availability of these systems than may have been anticipated at the outset of this study.

19. Industrialized building systems should not be considered the single most economical construction method for all building applications. For example, conventional construction proved more economical for one pilot project. However, industrialized building systems should be considered suitable and competitive for MCA facilities and should be given the opportunity to compete in procurements.

Project Execution and Specific Problem Areas

One of the objectives of this report was to identify any problem areas associated with the design and procurement method used in these projects. No fundamental problems were apparent in executing a two-step procurement intended to attract industrialized building systems. However, some situations did arise that were not typical of a conventional MCA project and these had to

be resolved. Most concerned the detailed mechanics of project execution rather than the basic properties of two-step procurement. Several trends were observed that may help avoid or resolve these problem areas in the future.

20. Although two-step procurement is a recognized procurement method, it is not widely used in MCA and, therefore, the proficiency does not equal that for conventional design-bid-build procedures. All three Districts involved were able to execute the projects, one having had no previous experience with two-step procurement in MCA. It was apparent, however, that two-step procurement was not "institutionalized" in the Districts as with the traditional approach. Thus, there was some confusion regarding authority to initiate a two-step procurement, the objectives and purpose, and the mechanics. Some District personnel noted a conspicuous lack of authoritative detailed procedural guidance in the Corps. However, Two-Step Formal Advertising is a recognized procurement method with provisions included in the FAR. Any problems probably can be resolved through better procedural guidance and greater experience with two-step procurement in MCA.

21. Overall administrative time and effort for two-step procurement should be no greater than for a traditional MCA project. However, there are shifts in responsibilities within the District that suggest an adjustment in work assignments--and associated accounting and funding exercises--would be appropriate. This would involve mainly the review and approval of contractor-generated construction documents. In a traditional MCA project, this is the District Engineering Division's responsibility before contract award and is administered out of design appropriations. In a two-step procurement, this responsibility shifts to a District's Construction Division after contract award, and is administered out of construction appropriations. However, a Contruction Division generally is not staffed to complete this task and it is turned back to Engineering Division. Personnel in charge of intra-District workload assignments and accounting will have to address this situation in future two-step procurements.

22. There was considerable diversity in RFTP composition and in AE effort among the three projects. RFTPs varied in format and composition, specificity of criteria, use of Corps of Engineers Guide Specifications, use of industry standards and model building codes, drawing composition, and latitudes offered to proposers. The levels of effort involved in RFTP development (and AE fees, when employed) also varied considerably. These dissimilarities suggest a need for uniform guidance within the Corps on RFTP composition and development for a two-step building procurement. This is not to imply that all RFTPs should be identical or that one approach is better than another, but greater consistency in development might improve future documents.

23. The facilities' users requested design changes after contract award for each project. Although this can occur under any circumstances, some changes might have been avoided had the users provided input at various stages in the process. Since the final, definitive architectural design is not completed until after contract award, the user should provide input regarding the design and suitable options indicated in the RFTP and should be represented in the proposal evaluation. It may also be appropriate for the user to provide input regarding architectural design during final construction document review and approval.

24. The concept design phase in two-step procurement presents some situations different than those in a conventional MCA project. Since there is no definitive design on which to base a concept estimate, the three Districts developed estimates based on what they felt to be the construction types and materials most likely to be proposed. This was to reflect the most competitive pricing for the procurement. The MCA design status report was also modified to reflect performance-based procurement. Relatively little definitive design work is completed--even in the final RFTP. In addition, the concept stage design progress report reflects progress toward completion of the RFTP, not final definitive design. OCE anticipated this situation in the Engineering Instructions and redefined "35 percent complete" accordingly for progress reporting. USA-CERL is, however, familiar with at least one two-step MCA project (not within this pilot project program) for which such provisions were not included in the OCE Engineering Instructions. The District involved reported an actual design completion of only a few percent. As a result, construction appropriations for that project were denied because of "insufficient design progress" and the project was delayed 1 year. The lesson here is that both District and OCE levels must be aware of this situation and make the necessary provisions at the outset of a project.

25. It is possible, and advantageous, for a District to advertise for step-1 proposals upon completion of the RFTP, even though that may be well in advance of construction funding authorization. This situation arose with two of the projects. Rather than wait, the Districts initiated action for early advertisement of step-1 proposals. This procedure is not inconsistent with the FAR because it does not commit the Government to expenditure without funding authorization. In these cases, however, the RFTPs included qualifications to proposers to indicate that step-2 bidding would not take place until funding was authorized. OCE did not address this issue in the Engineering Instructions; the Districts resolved it on their own initiative.

26. Proposers indicated that their cost to develop proposals and bids was two to five times the normal bidding cost. Although some proposers said the step-1 submittals might have been less extensive, none found the process unreasonable enough to discourage participation. One common concern the proposers had was that all submitted material should be considered carefully so that their efforts were not wasted. Another was that the RFTPs could have provided more guidance indicating what was "good enough" to be judged acceptable while not necessitating an uncompetitive bid price.

27. Potential proposers for two-step procurement are not necessarily the usual bidders in conventional Corps projects. When Districts notified firms other than those on their standard bidders list, participation in the projects was quite good. When one District notified only the standard bidder's list, participation was low. This would suggest that the Corps should seek other types of participants, in addition to the usual bidders, when notifying firms of a design/build procurement. This pool may include design/build contractors, construction management firms, AEs, AE/contractor joint ventures, and building system franchise contractors.

28. Proposers have indicated that the inclusion of all step-2 bidding material in the RFTP is of considerable value to them. Although this material does not apply directly to the step-1 proposal, it defines the "rules of the game" to proposers. One critical item is indication of the maximum contract

award ceiling in the RFTP. This information is necessary for the proposer to develop a facility design responsive to the Government's economic constraints as well as the technical requirements. The low bid award basis maintains competitive pricing. One District simply indicated a broad construction cost range in its RFTP; a maximum contract award amount was indicated in the IFB--after proposal development. This forced at least one proposer to withdraw from the procurement because his proposal could not be bid under the maximum allowable amount.

29. In the contruction of each facility, minor problems were experienced that Corps field personnel attributed to ambiguities or differences in interpretation of RFTP provisions. In one case, an RFTP even omitted necessary requirements. However, these situations are to be expected in any construction project; none created any serious difficulties and all projects were well within the 5 percent programmed for contingencies. However, the occurrence of ambiguities reinforces the need for care in preparation and review of an RFTP, just like with conventional construction documents.

30. Phasing design and construction after contract award saved a considerable amount of construction time. All three contractors indicated overhead cost savings associated with reduced construction time, and therefore could submit lower bids when given the opportunity to shorten construction duration.

31. The only problem of any consequence related to two-step procurement in the three projects occurred in the review and approval process for contractor-generated construction documents. The problem involved the unspecified turnaround time for Corps review of these documents. Because the contractors' bids depended to a large extent on time spent on the job, they anticipated a quick approval of their documents. The RFTPs, however, left this an "open-ended" arrangement without designating any maximum time the Corps could take for approval. The contractors indicated they could have been vulnerable to unanticipated delays in approval which would have cost them time, and therefore, money. This issue is especially critical when documentation is phased with construction. Furthermore, some review comments and resubmittal requirements reflected individual preferences rather than simply verifying conformance to the RFTP. Both the contractors and the Corps indicated that these difficulties might have been minimized or avoided had (a) the RFTP indicated a minimum and maximum turnaround time for document review and approval, and (b) the reviewers confined their review to what was "acceptable" or "unacceptable" according to the RFTP rather than professional or personal preferences.

32. From the Corps' perspective, construction was administered in essentially the same way as a conventional MCA project. Project engineers reported QA demanded less effort, whereas administration, payment, and close-out were all conducted as usual.

7 CONCLUSIONS AND RECOMMENDATIONS

Three MCA projects have been administered using a two-step procurement procedure instead of the more typical design/bid/build method. This pilot program achieved positive results in terms of project cost, time, and quality. Overall project costs were 28 to 32 percent below estimates for conventional procurement, and in two of the projects, construction was completed in 50 to 75 percent of the usual time. The facilities' design and construction quality are judged to be as good as expected for conventional MCA projects.

Savings in project cost are attributed to the "design/build" feature of two-step procurement in which the contractor supplies all final documentation and absorbs the cost of possible errors. In addition, proposers for these three projects were allowed to submit industrialized, preengineered construction as an alternative to conventional method for even greater savings. (However, conventional construction proved more economical for one facility.)

One drawback with two-step procurement is that firms proposing a higher quality design than the minimum acceptance standard may not be awarded the contract, even though their bid is within the Government-estimated range. That is, no credit can be given for better designs--any proposal meeting the specifications will win if it is the low bid.

Other problems in the two-step process apparently were related to a lack of experience with this method by both the Corps and construction industry. As personnel become more familiar with this process, certain phases should move much faster and more smoothly.

The Corps Districts and Divisions and the contractors involved in these three pilot projects all responded favorably to two-step procurement for MCA. Based on their experience, the following recommendations are made:

1. Two-Step Formal Advertising procurement should be used in future MCA projects if conditions favor such an approach.

2. When construction is phased with documentation review, the Corps should schedule a quick turnaround time. This would help contractors control overhead costs, thus enabling them to submit lower bids.

3. The objectives and mechanics of two-step procurement should be defined clearly and procedural guidance should be provided.

4. The OCE Engineering Instructions for a two-step procurement project should contain provisions for situations that will differ from normal procurement. For example, the percentage "complete" at any given reporting stage should reflect requirements that will be in the RFTP.

5. One-step procurement should be used in projects for which design, technical quality, life cycle cost, and bid price can be evaluated and factored into the contract award structure.

APPENDIX A:

RFTP CONTENTS

Fort Drum Battalion Headquarters and Classroom Facility

Letter from District Engineer

Administrative Provisions
1. Intact
2. Step I
3. Step II
4. Proprietary Data
5. Requirement for Registration of Designers
6. Bid Bonds, Performance, and Payment Bonds
7. The Design & Construction Period
8. Base Bid/Additive Bid Items
9. References to Attached Submittal Forms

1. General
2. Architectural
3. Site Planning Criteria
4. Structural Systems
5. Utility Systems

Calculations, Specifications, Catalogue Cuts and Drawings
(This section identifies that information which the contractor was to address and include with all other Step 1 proposal submittals)

Part 2 Site
Part 3 Structural
Part 4 Exterior Wall
Part 5 Thermal Enclosure
Part 6 Horizontal Construction
Part 7 Miscellaneous Interior Work
Part 8 Mechanical
Part 9 Plumbing
Part 10 Electrical

Technical Proposal Form
(Construction Contract)

Special Provisions
SP-1 Commencement, Prosecution, and Corporation of Work
SP-2 Contract Drawings, Maps, Specifications
SP-3 Performance of Work by Contractor
SP-4 Shop Drawings Design and (Drawings)
SP-5 Physical Data
SP-6/SP-7 Not Used
SP-8 Availability of Utility Services
SP-9/SP-10 Not Used
SP-11 Identification of Employees
SP-12/SP-13/SP-14 Not Used

SP-15 Liquidation Damages
SP-16 Not Used
SP-17 Required Insurance
SP-18 Layout of Work
SP-19/SP-20 Not Used
SP-21 Contractor-Prepared Network Analysis System
SP-22/SP-23/SP-24 No Text
SP-25 Certificates of Compliance
SP-26 Payment
SP-27 Cooperation With Using Agency and Other Contractors
SP-28 Coordination of Trades
SP-29 Construction Lighting
SP-30 Record Drawings
SP-31 Safety Sign
SP-32 Project Sign
SP-33/SP-34/SP-35 Not Used
SP-36 Designation of Property Administrator
SP-37 Not Used
SP-38 Head Protection
SP-39 Design and Shop Drawing and Material Submittals
SP-40 Contractor Quality Control
SP-41 Warranty of Construction
SP-42 Not Used
SP-43 Rollover Protective Structures
SP-44 Temporary Wood Filler on Stair Treads and Landings
SP-45 Not Used
SP-46 Payment for Off-Site Materials
SP-47 Interruption of Electric Service
SP-48 Power Transmission Line Safety Procedures
SP-49 Not Used
SP-50 Heating and Hot Water System
SP-51 Equipment Ownership and Operating Expense Schedule

General (Project Specifications)

Part 1 - General Conditions and Requirements
Part 2 - Site
Part 3 - Structure
Part 4 - Exterior Walls
Part 5 - Thermal Enclosure
Part 6 - Horizontal Construction: Roofing, Ceiling
Part 7 - Miscellaneous Interior Work
Part 8 - General Requirements: HVAC
Part 9 - General Requirements: Plumbing
Part 10 - Electrical

Appendix 1 - Subsurface Exploration Report

Drawings -

Location Plan
Site Plan
Floor Plan
Elevations
Heating and Ventilation

Fort Benjamin Harrison Physical Fitness Facility

Request for Technical Proposals
1. Location and General Description of the Work
2. Procurement Procedure
3. Late Technical Proposals, Modifications of Technical Proposals, and Withdrawals of Technical Proposals
4. Availability of Specifications, Standards, and Descriptions
5. Registration of Designers
6. Inquiries
7. Proposal Sites
8. Termination of Solicitation

Instructions for Proposal Preparation
1. General
2. Proposal Preparation
3. Proposed Sponsor Identification
4. Directions for Submitting Proposals
5. Restrictions on Disclosure and Use of Data
6. Disposal of Proposals

Section EV-1 - Evaluation of Technical Proposals and Bids
1. General
2. Selection
3. Evaluation
4. Contracting Officer's Decision

Section T1 - Environmental Construction Permits and Protection
1. Permits
2. General
3. Implementation
4. Preconstruction Survey
5. Protection of Land Area
6. Protection of Water Resources
7. Waste Disposal
8. Burning
9. Dust Control
10. Erosion Control
11. Corrective Action
12. Postconstruction Cleanup or Obliteration

Section T2 - Foundation Report
1. Subsurface Investigation
2. General Geology
3. Site Geology
4. Earthquake History
5. Laboratory Testing
6. Laboratory and Field Data
7. Adopted Design Data

tion T3 - Architectural
1. General
2. Submission Documents
3. Building Form
4. Design Instructions
5. Materials
6. Handball Court Walls, Doors, Hardware, and Windows
7. Screens
8. Built-up Roofing
9. Curtains
10. Pre-Engineered Building Systems
11. Painting Schedule

tion T4 - Structural
1. Codes, Manuals and Standards
2. Design Loads
3. Structural Systems
4. Material and Construction Requirements
5. Excavation, Filling, and Backfilling for Buildings
6. Submittals

tion T5 - Mechanical
1. General
2. Plumbing
3. Heating, Ventilation, and Air Conditioning
4. Energy Budget
5. Swimming Pool Water Circulation Filtration and Disinfection
6. Tests

tion T6 - Electrical
1. Exterior Electrical
2. Interior Electrical
3. Specifications

tion T6A - Electrical Work, Interior
1. Applicable Publications
2. General
3. Materials and Equipment
4. Approval of Materials and Equipment
5. Submittals
6. Grounding
7. Wiring Methods
8. Receptacles
9. Wall Switches
10. Panelboards
11. Motors
12. Motor Control
13. Lamps and Lighting Fixtures
14. Tests

Section T6B - Electrical - Distribution and Street-Lighting System; Underground

1. Applicable Publications
2. General
3. Materials and Equipment
4. Submittals
5. Workmanship
6. Duct System
7. Manholes
8. Primary Cable System
9. High-Voltage Cable Terminations
10. Pad Mounted, Tamper-proof, Compartmental Type, Mineral Oil Insulated, Self-Cooled Transformers, 2500 KVA - and Smaller
11. Secondary Cable System
12. Street-Lighting System
13. Luminaires
14. Grounding
15. Connections Between Aerial and Underground Sections
16. Tests

TB MED 163 - Sanitary Control of Army Swimming Pools and Swimming Areas

Drawings -

Location Plan and Index
Boring Logs
Architectural Floor Plan
Architectural Swimming Pool Plan
Exterior Removal Plan
Utilities Site Plan

:ewart Fire Station

: for Proposals
  Intent
  Step I
  Step II
  Proprietary Data
  Requirement for Registration of Designers
  Bid Bonds, Performance, and Payment Bonds
  The Design and Construction Period
  Identification of Basic Item Work for Bid
  Reference to Submittal Formwork
  Evaluation of Proposals
  Technical Proposal Requirements
  Contract Requirements

ix I - Special Provisions
  Statement of Intent
  Method of Procurement
  Nonconforming Proposals
  Time for Acceptance by the Government of Proposals
  Clarification of the Provisions of This Request
  Required Technical Data for Proposal Submissions
  Commencement, Prosecution and Completion of Work
  Liquidation Damages
  Exception to Completion and Liquidated Damages Schedules
  Limitation of Payment for Design
  Time Extensions
  Shop Drawing and Material Submittal Scheduling and Control
  Applicable Codes and Standards
  Submission of Construction Drawings, Specifications, and
  Design Analyses
  Approvals Prior to Construction
  Responsibility of the Contractor
  Availability of Utility Services
  Facilities Available to the Contractor
  Required Insurance
  Safety
  Erection of Signs
  Inspection
  Review of Shop Drawings
  Environment Protection
  As-Built Drawings
  Inventory of Installed Property
  Operating and Maintenance Instructions
  Project Requirements

ix II - Outline Specification
line specification work sheets in CSI 16 division format to be completed
proposer and included with Step I submittals.

ix III - Technical Proposal Form (Construction Contract)

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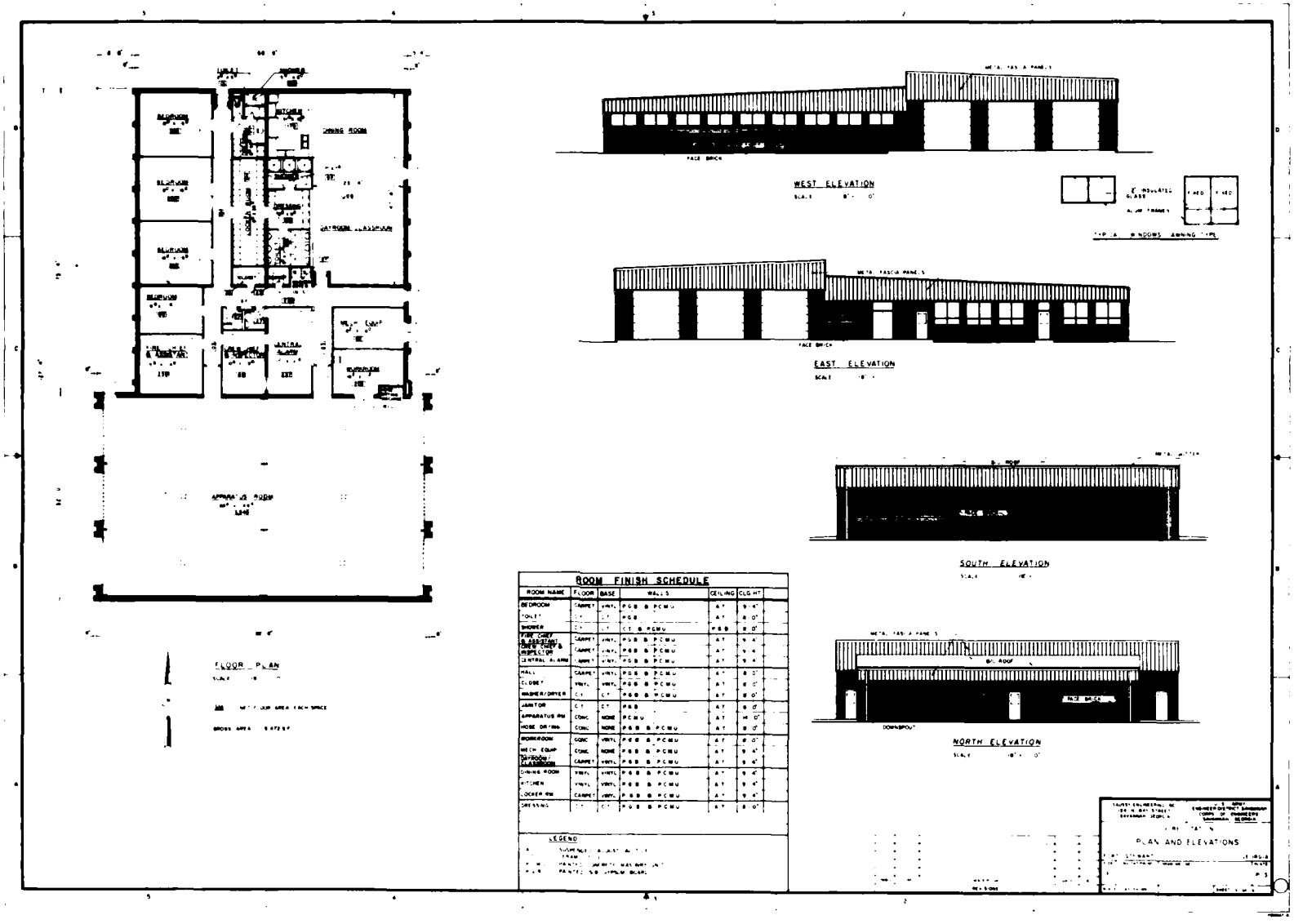


Figure B9. Elevations--Fort Stewart project.

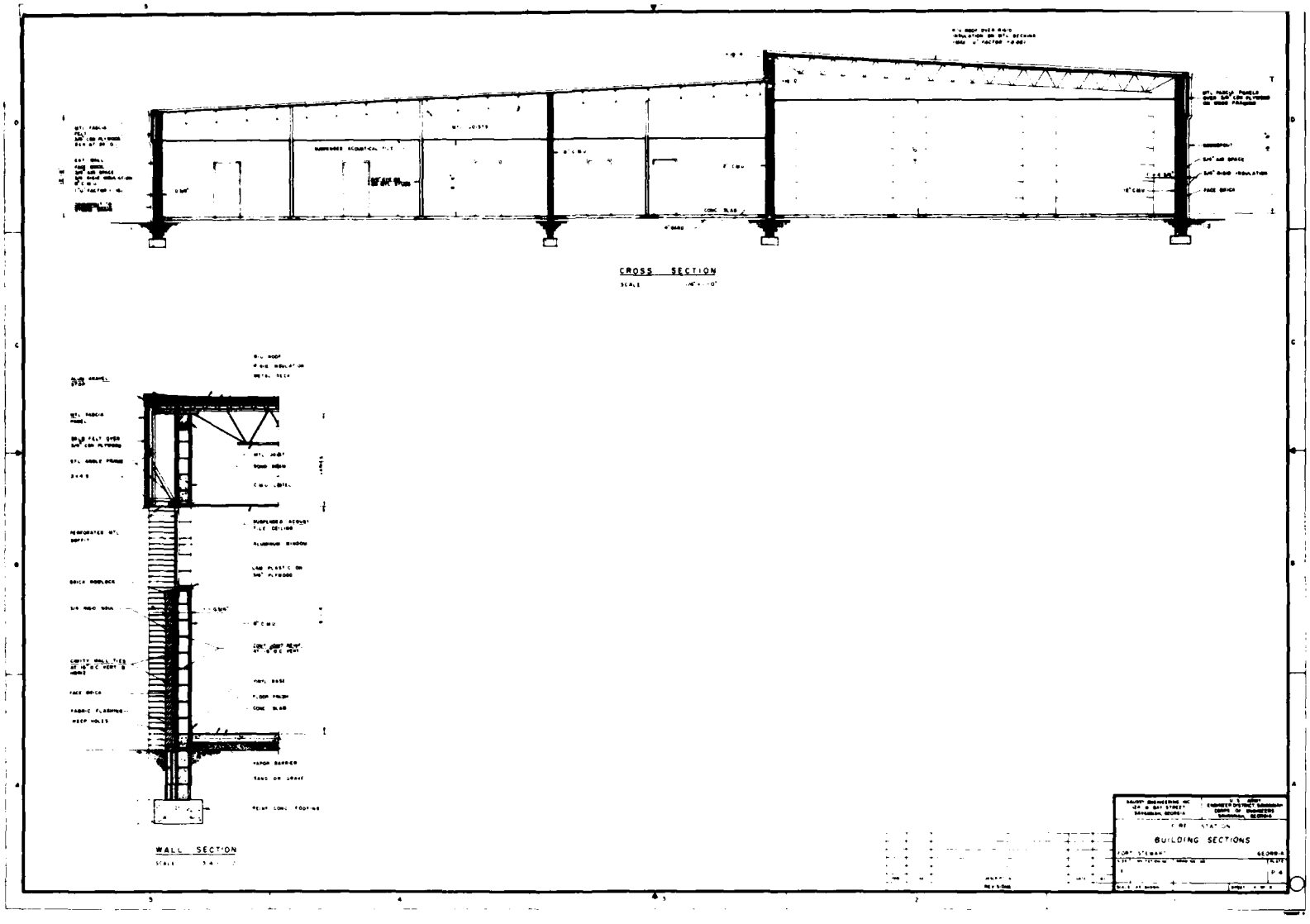


Figure B8. Building section--Fort Stewart project.

Fort Stewart Fire Station

Outline Specifications -
Consist of a brief statement of work to be included, qualifications of workers, materials, installation, code and industry standards, manufacturer's catalog cuts.

References to Savannah District Guide Specifications.

Drawings:
- Floor plan
- Elevations
- Building section
- Typical wall section.

Figures B8 and B9 show the drawings submitted.

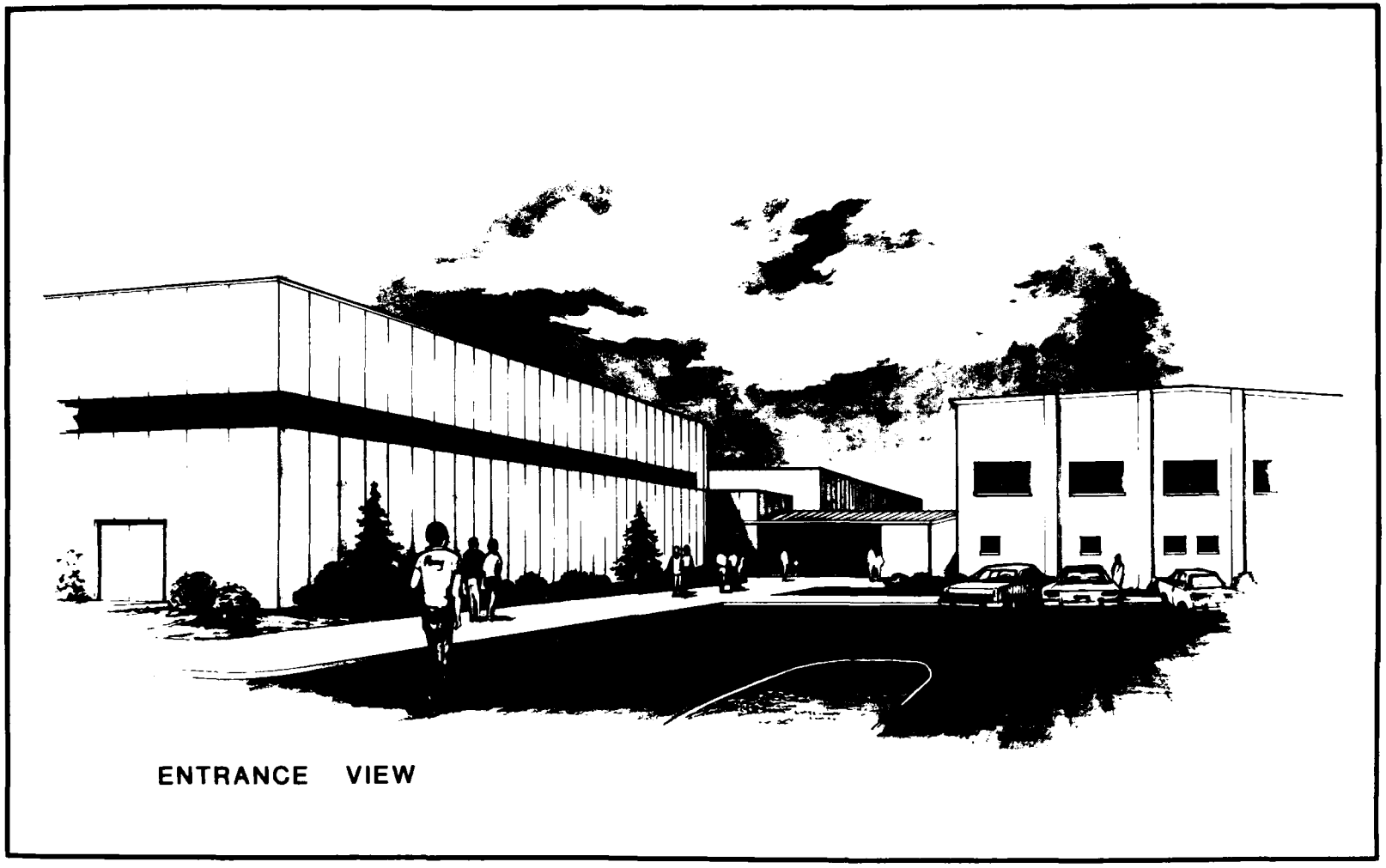
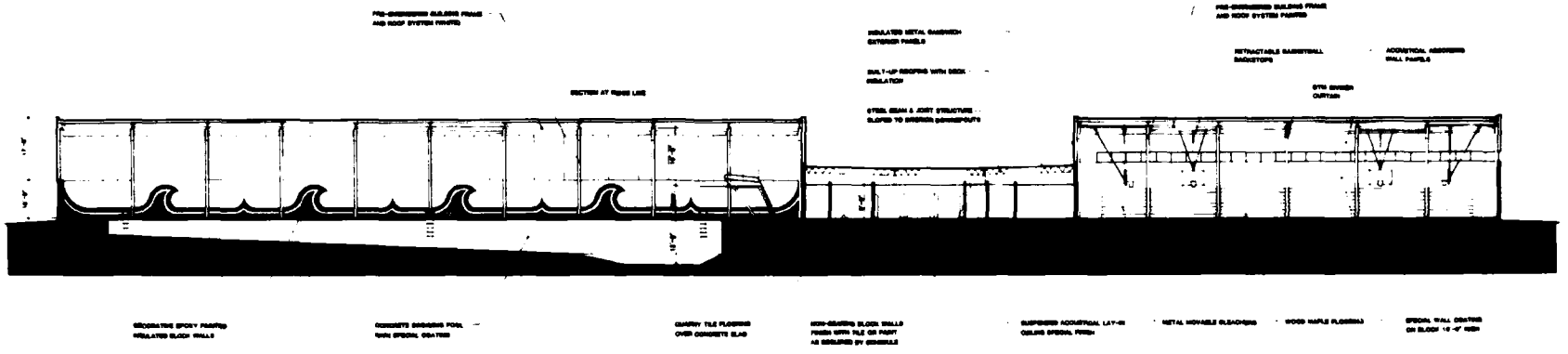


Figure B7. Front entrance view--Fort Benjamin Harrison project.



BUILDING SECTION A-A SCALE

I.D. NO. 255

Figure B6. Building section A-A--Fort Benjamin Harrison project.

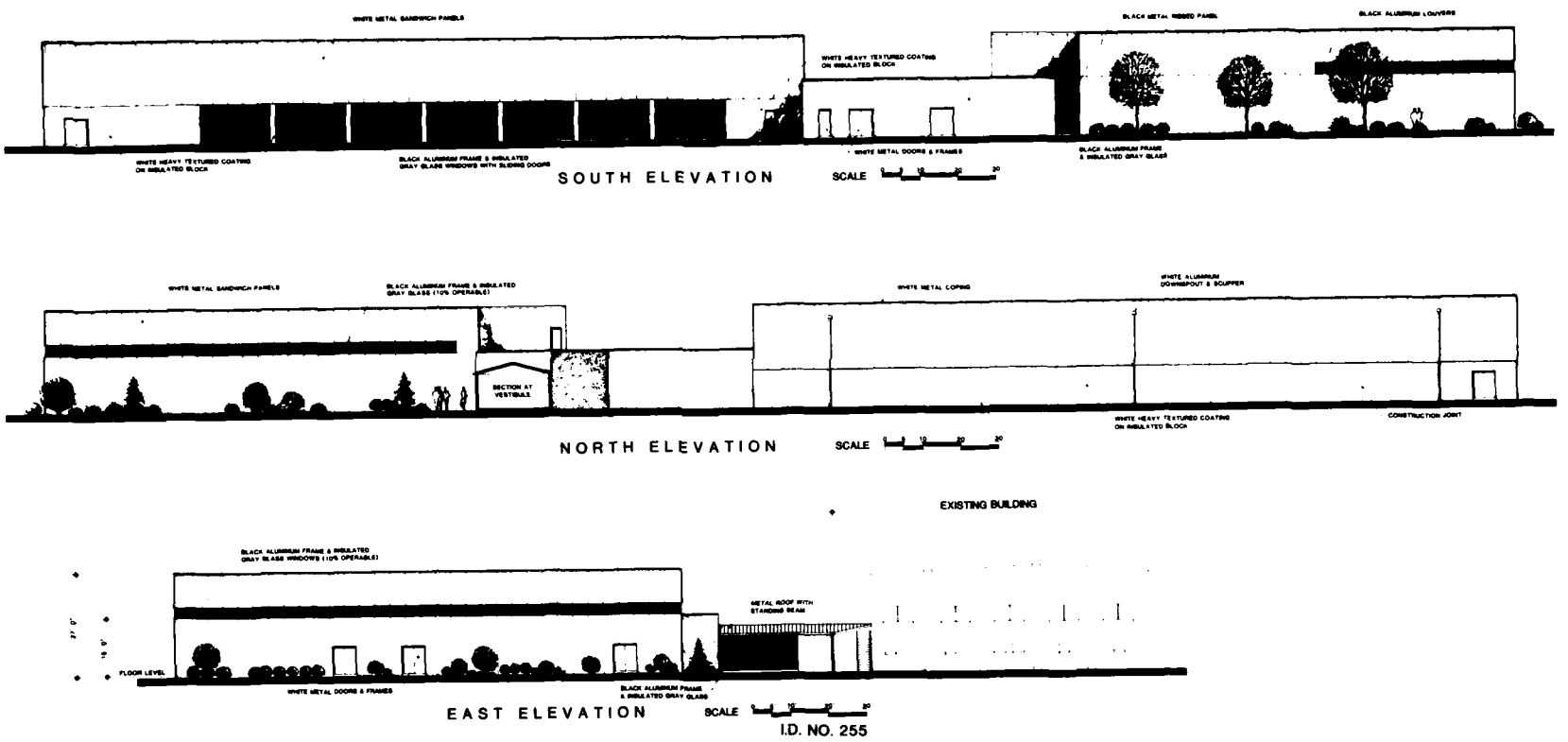


Figure B5. Elevations--Fort Benjamin Harrison project.

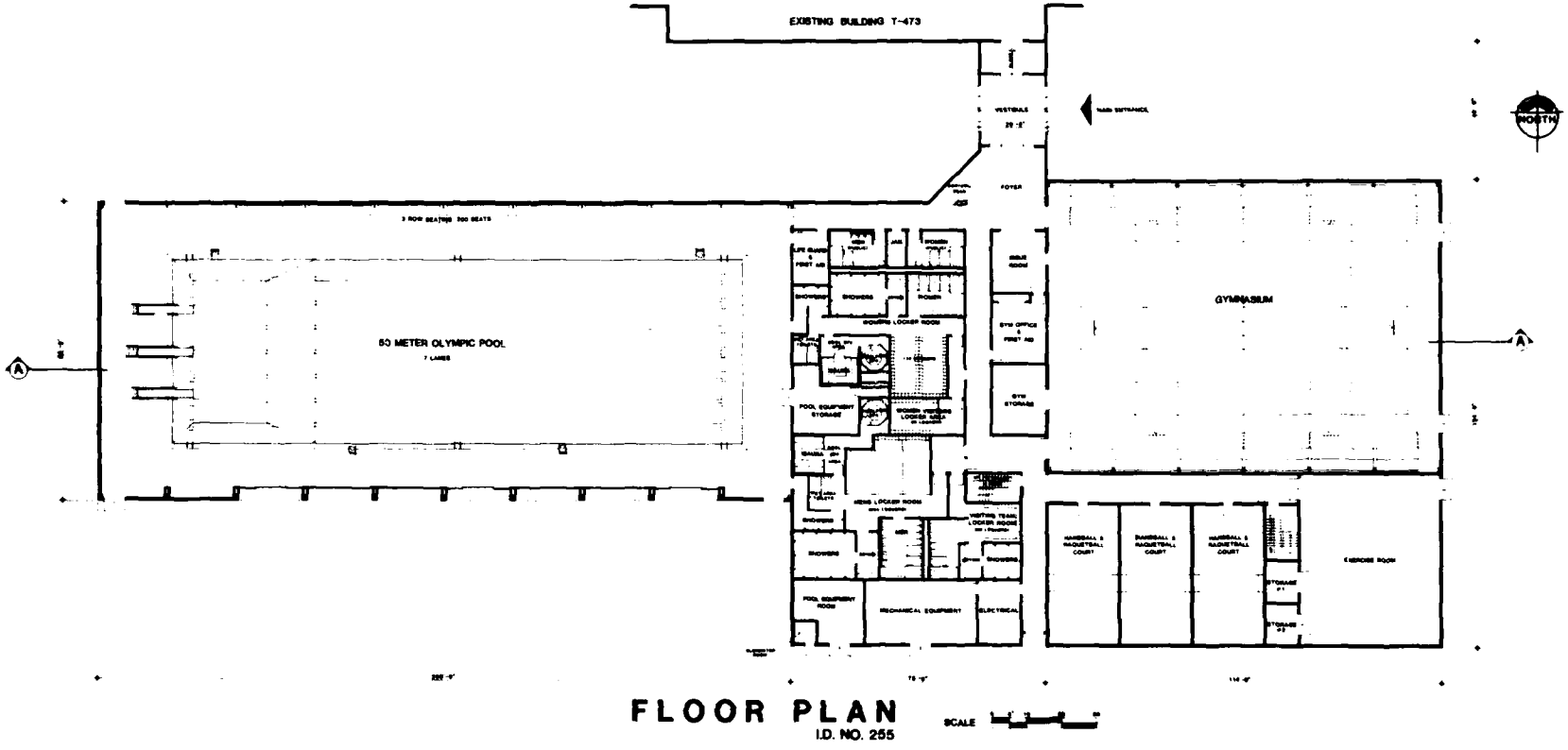


Figure B4. Floor plan--Fort Benjamin Harrison project.

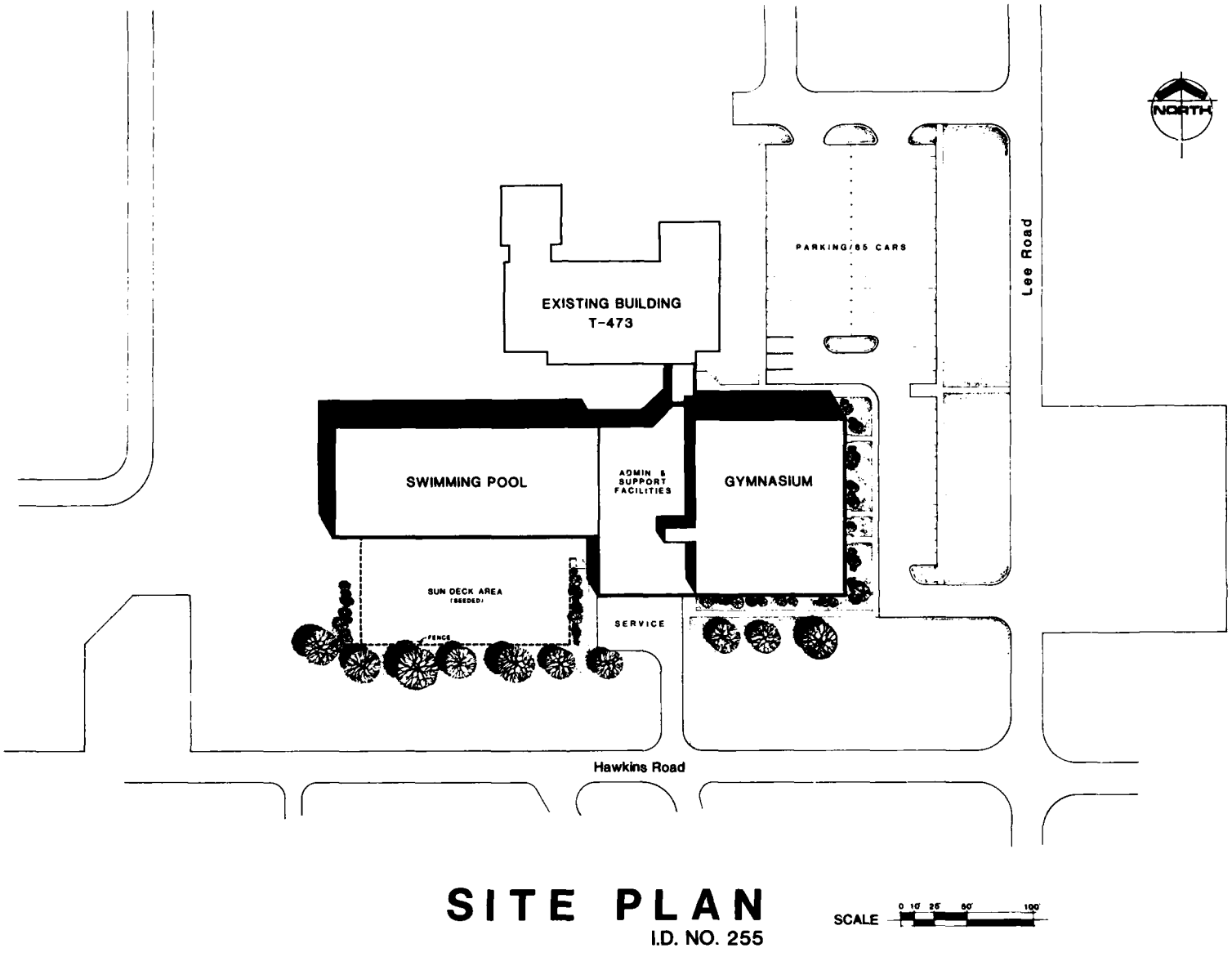


Figure B3. Site plan--Fort Benjamin Harrison project.

Fort Benjamin Harrison Physical Fitness Facility

Concept Design Analysis -
General description of overall design, subsystems and components.

Preliminary Energy Budget Analysis
- Swimming pool area
- Gymnasium area

Outline specifications
- 16 division CSI format

Drawings:
- Site plan
- Floor plan
- Elevations
- Building cross section
- Perspective.

Figures B3 through B7 show the drawings submitted.

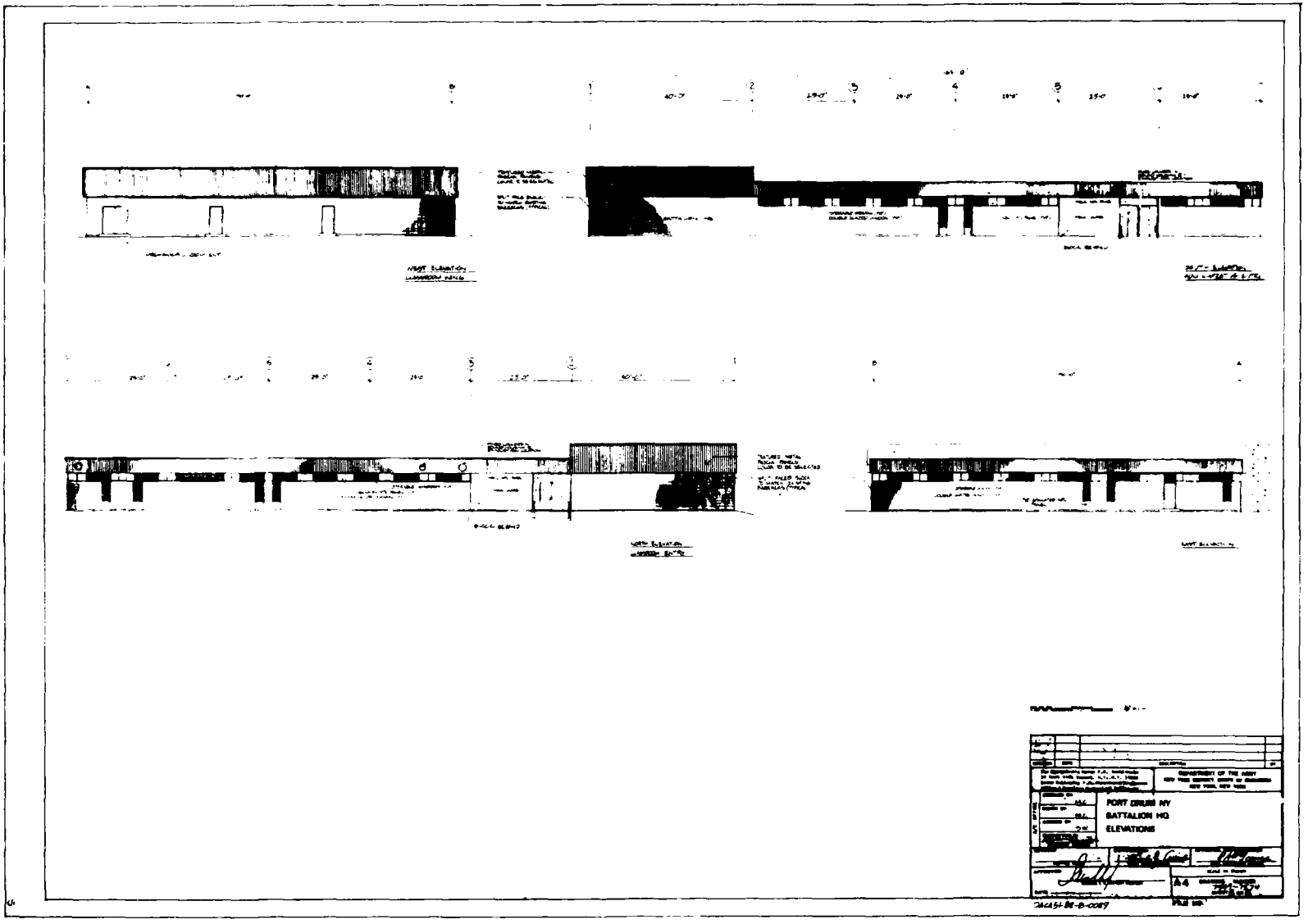


Figure B2. Elevations--Fort Drum project.

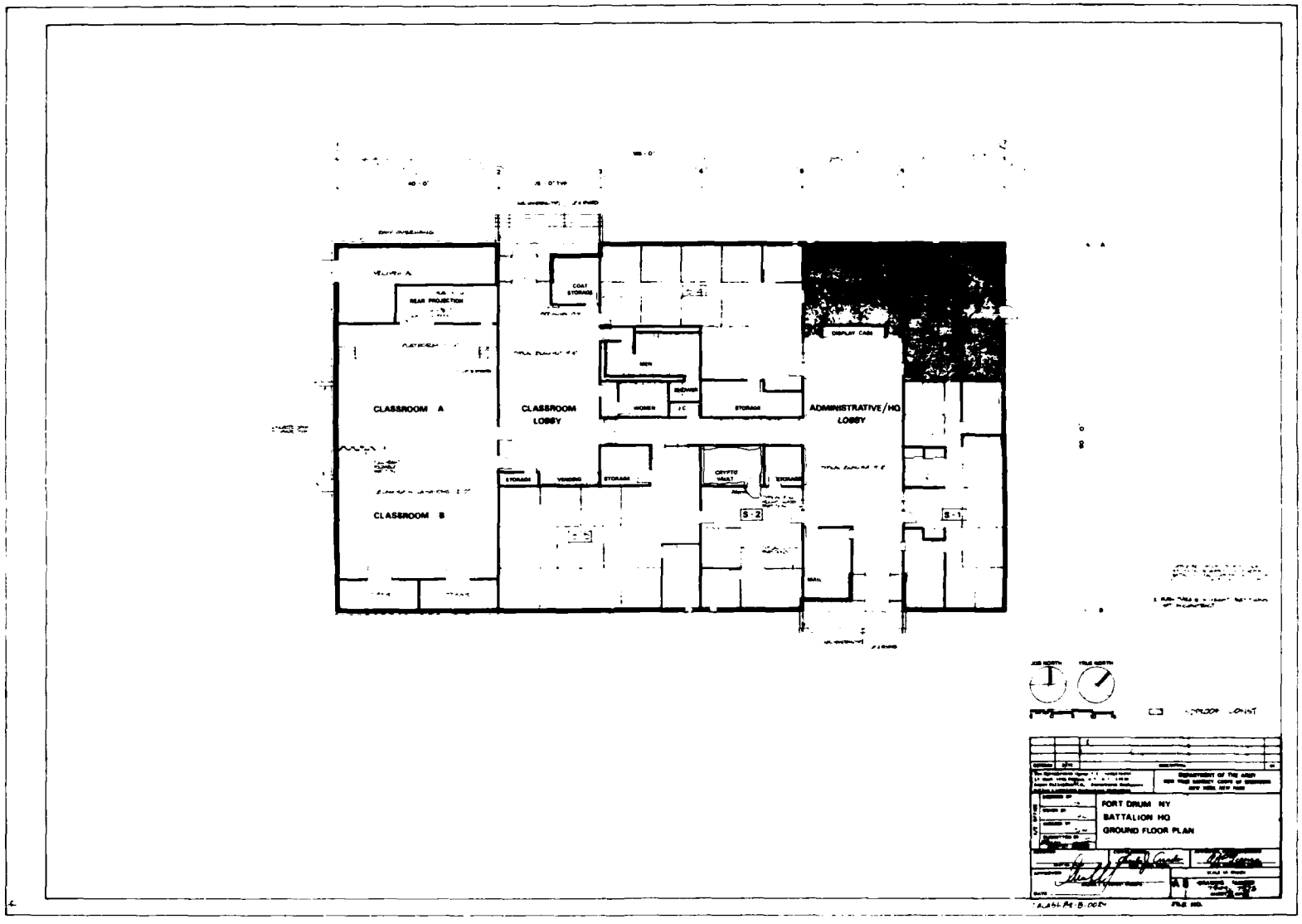


Figure B1. Ground floor plan--Fort Drum project.

APPENDIX B:

WINNING PROPOSAL SUBMITTALS FOR EACH PILOT PROJECT

Fort Drum Battalion Headquarters and Classroom Facility

Preliminary Specifications

General description of Armco Building System and outline specification addressing design, material, components and engineering of:

- Structural system
- Facade system
- Roof system
- Gutter and downspouts
- Insulation
- Foundation system
- Floor system
- Ceiling system
- Finishes.

Anticipated documentation and construction period
Statement that design, engineering and construction will conform to RFTP criteria, code, and industry standards.
Statement that all work will be done by licensed professionals.
Armco Building System warranty
Manufacturer's catalog cuts on:

- Toilet partitions
- Windows
- Folding partitions
- Vault door.

Drawings:

- Site plan
- Floor plan
- Large scale plan details
- Wall section details
- Elevations.

Figures B1 and B2 show the drawings submitted with this proposal.

Appendix IV - Project Development Requirements

1. Functional Description
2. Design Criteria
3. Existing Conditions
4. Site Requirements
5. Architectural and Structural Requirements
6. Mechanical Requirements
7. Water and Sewer Utilities
8. Electrical Requirements
9. Active Solar System

Appendix V - Site Condition Survey

1. General
2. Project Site
3. Geology
4. Investigation
5. Soil Conditions
6. Ground Water Conditions
7. Foundation Considerations
8. Borrow Areas
9. Erosion Control
10. Seismic Zone
11. Clearing and Disposal

Appendix VI - Boring Logs and Soil Test Data

Drawings

Habitability Team Distribution

US Army Engineer Districts (41)
ATTN: Chief, Engineer Division

US Army Engineer Divisions (14)
ATTN: Chief, Engineer Division

USA DARCOM 22333
ATTN: DRCIS

Fort Leavenworth, KS 66027
ATTN: ATZLCA-SA

Patrick AFB, FL 32925
ATTN: XRQ

Tyndall AFB, FL 32403
ATTN: RD

Director, Bldg Technology & Safety Div 20410

Director, Center for Bldg Technology 20234

Energy Research & Development Foundation 20234

National Institute of Bldg Sciences 20006

Public Building Service 20405

Huntsville Division (2)
ATTN: HND-DE

St. Louis District (2)
ATTN: LMS-ED-P

Missouri River Division (2)
ATTN: MRD-ED

Kansas City District (2)
ATTN: MRK-ED-M

North Atlantic Division (2)
ATTN: NAD-EN

Baltimore and Baltimore Harbor District (2)
ATTN: NAB-EN-MA

New York and New York Harbor District (2)
ATTN: NAN-EN-MA

Norfolk and Norfolk Harbor District (2)
ATTN: NAO-EN-M

North Pacific Division (2)
ATTN: NPD-EN

South Atlantic Division (2)
ATTN: SAD-EN-M

Mobile District (2)
ATTN: SAM-EN-M

Savannah District (2)
ATTN: SAS-EN-M

Omaha District (2)
ATTN: MRO-ED-M

New England Division (2)
ATTN: NED-ED-D

Alaska District (2)
ATTN: NPA-EN-M

Portland District (2)
ATTN: NPP-EN

Seattle District (2)
ATTN: NPS-EN-DB

Ohio River Division (2)
ATTN: ORD-ED-M

Louisville District (2)
ATTN: ORL-ED-M

Pacific Ocean Division (2)
ATTN: POD-EN

South Pacific Division (2)
ATTN: SPD-ED

Los Angeles District (2)
ATTN: SPL-ED-D

Sacramento District (2)
ATTN: SPK-ED-M

Fort Worth District (2)
ATTN: SWF-ED-M

Tulsa District (2)
ATTN: SWT-CD

HQ TRADOC (2)
ATTN: ATEN-C
Ft. Monroe, VA 23651

USA DARCOM (2)
Installation & Services Activity
ATTN: DRCIS-RI-IC
Rock Island, IL 61299

HQ FORSCOM (2)
ATTN: AFEN-CD
Ft. McPherson, GA 30330

US Army Air Traffic Control Activity
ATTN: CCQ-DD
Ft. Hauchuca, AZ 85613

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